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Miyai

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(54) **LOOP PRESSER, FLATBED KNITTING MACHINE HAVING LOOP PRESSER, AND FABRIC KNITTING METHOD USING LOOP PRESSER**

(75) Inventor: **Takuya Miyai**, Wakayama (JP)

(73) Assignee: **Shima Seiki Manufacturing Limited**, Wakayama (JP)

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(51) **Int. Cl.**[7] **D04B 15/02**
(52) **U.S. Cl.** **66/95**; 66/64
(58) **Field of Search** ..... 66/95, 96 R, 96 W, 66/97, 64, 60 R, 147

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Primary Examiner—Danny Worrell
(74) *Attorney, Agent, or Firm*—Wenderoth, Lind & Ponack, L.L.P.

(57) **ABSTRACT**

An object of the invention is to improve yarn feeding conditions to a knitting needle and improve a loop pressing function and a yarn holding function for end stitches in a flat knitting machine provided with a compound needle. In a top portion **12** of a loop presser **11** advancing to a tooth mouth **10**, a knitting yarn holding portion for end stitches **13** and a loop presser portion **14** are formed. The knitting yarn holding portion for end stitches **13** hides a tongue **25***a* from the yarn **22** at a wall portion **15** above the knitting yarn holding portion for end stitches **13** so that the problem of yarn entanglement that the yarn **22** fed to a hook **24***a* of the compound needle **23** from a yarn feeding port **20** is surmounted on the tongue **25***a* may be solved. A pressing portion **16** below the knitting yarn holding portion for end stitches **13** presses the yarn **22**. The knitting yarn holding portion for end stitches **13** holds the yarn **22** outside the end stitch by winding it around it. The loop presser portion **14** presses the yarn **22** during the knitting. While hiding the tongue **25***a* of the needle **23** of the end stitch at the wall portion **15**, the yarn **22** can be guided into the hook **24***a* reliably by causing the loop presser portion **14** of another loop presser **11** to act.

15 Claims, 13 Drawing Sheets

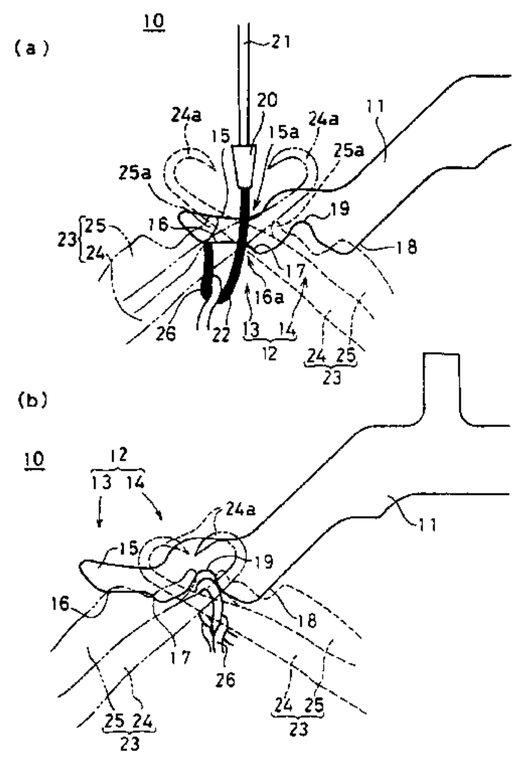
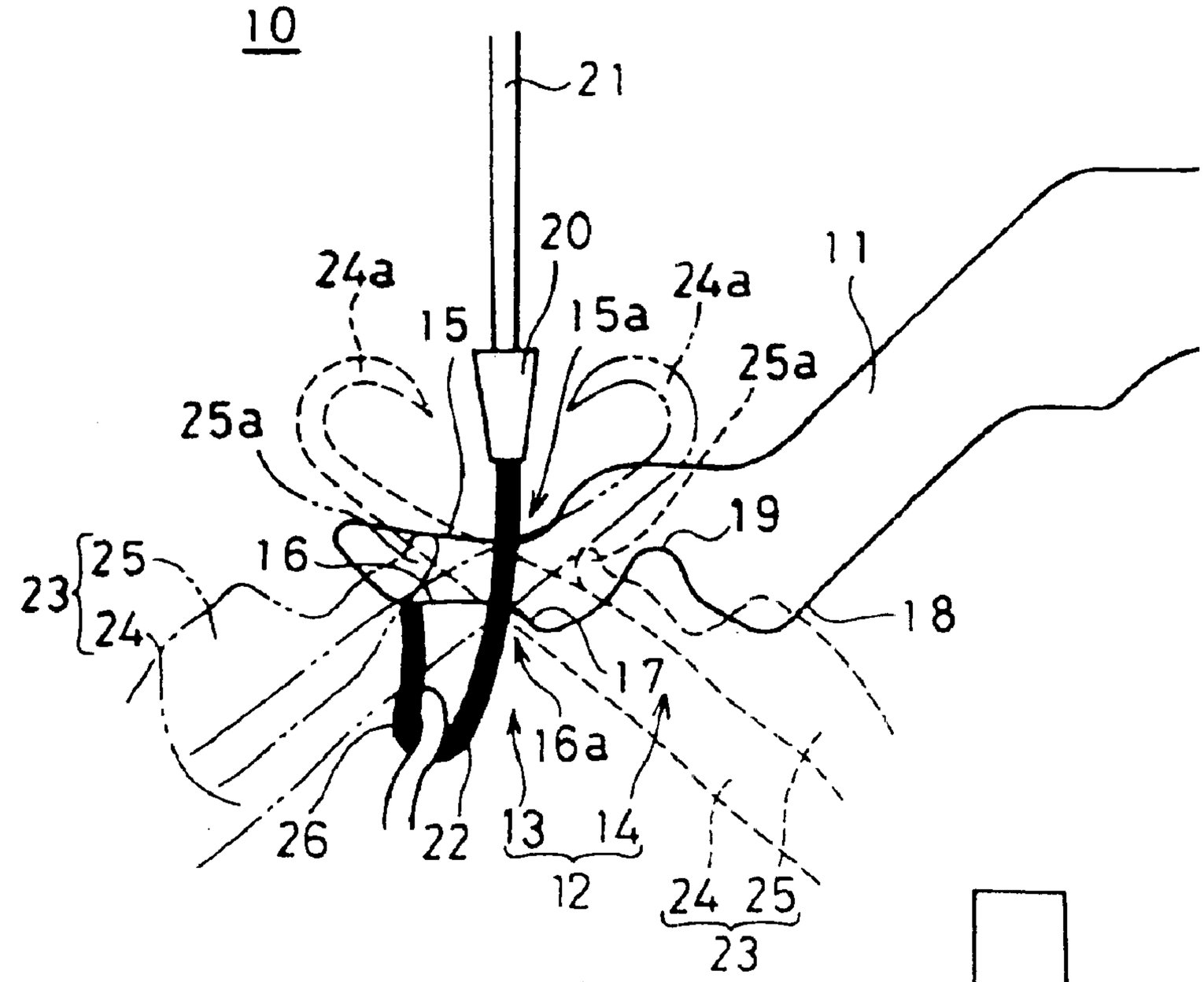


FIG. 1

(a)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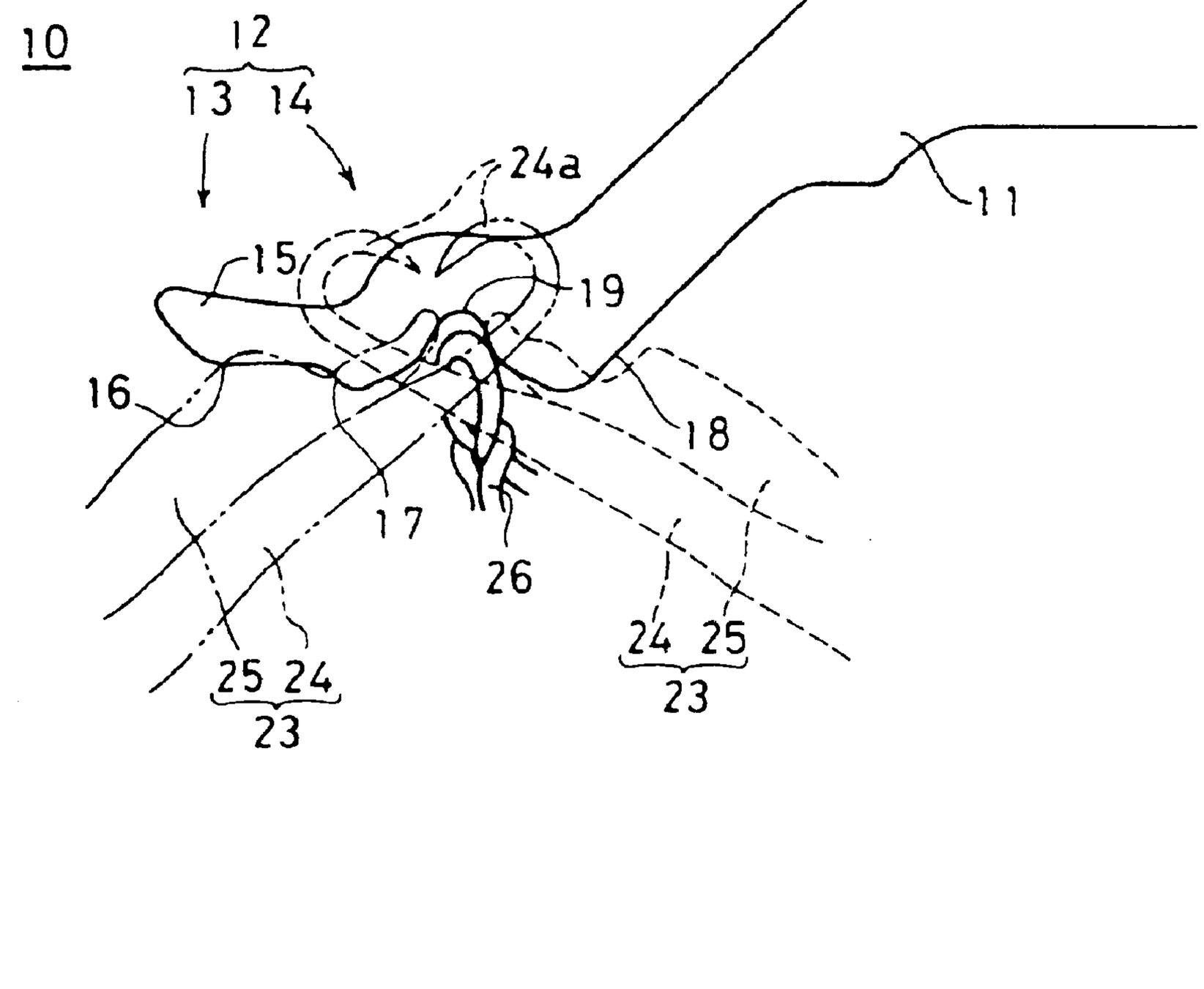
(b)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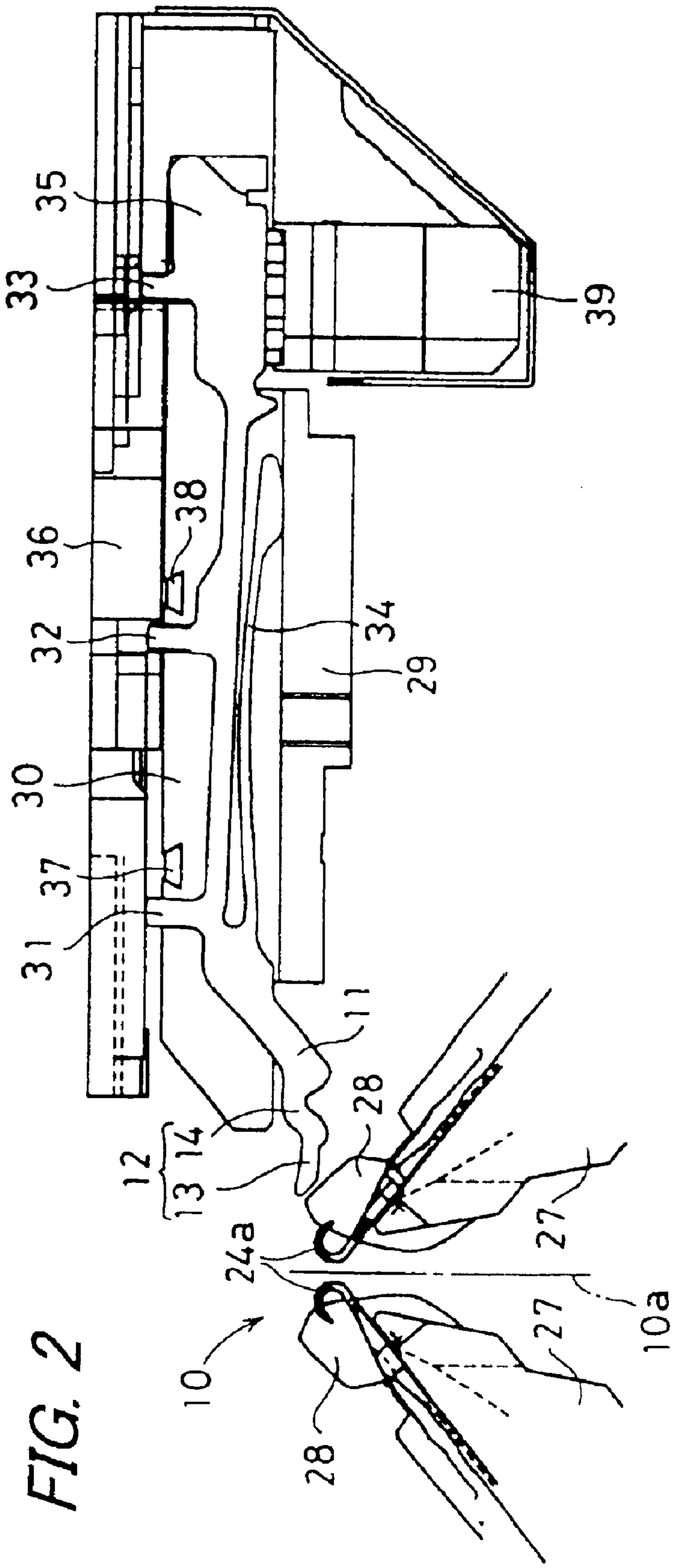
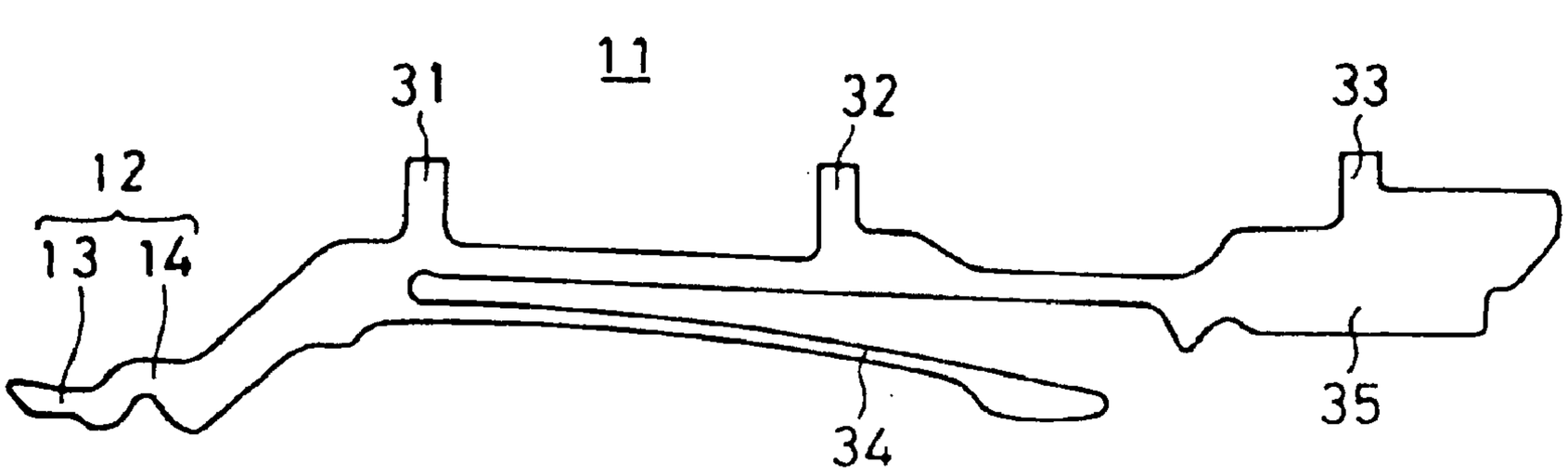


FIG. 2

FIG. 3

(a)



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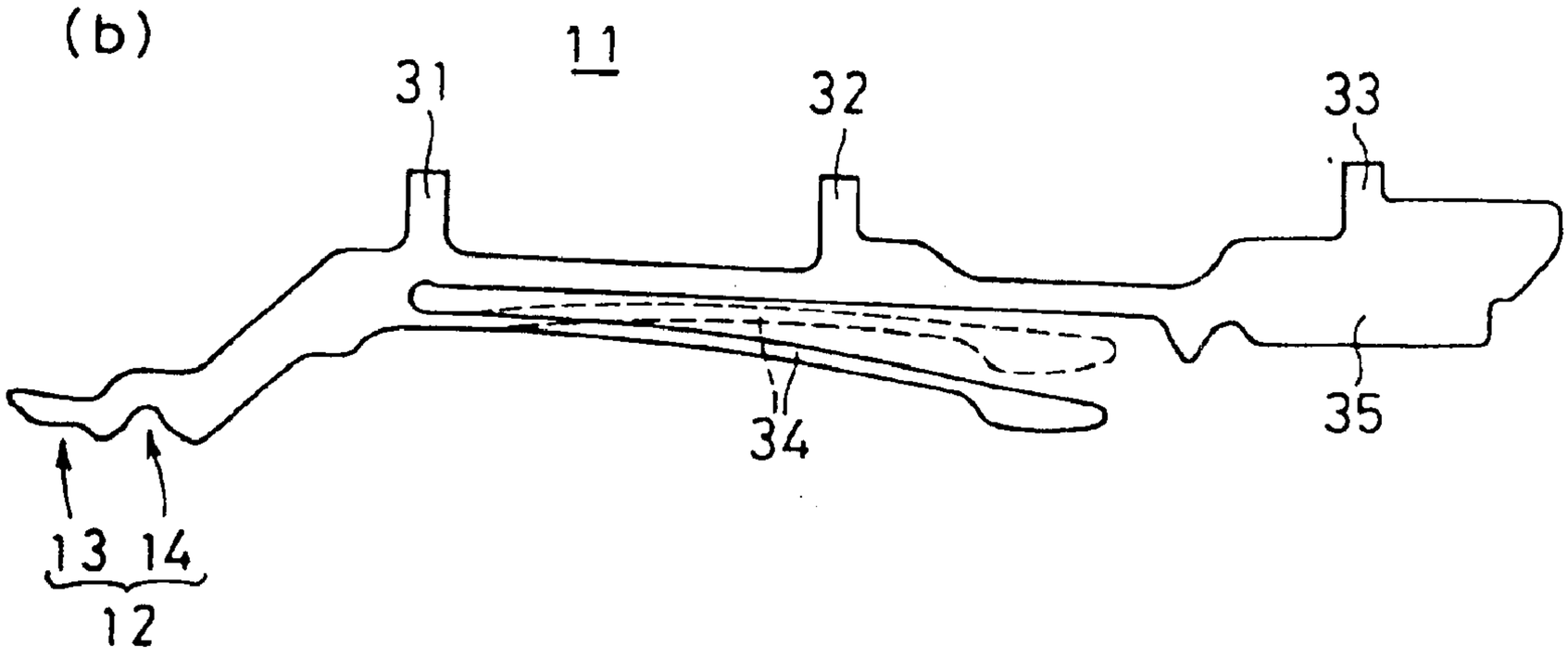
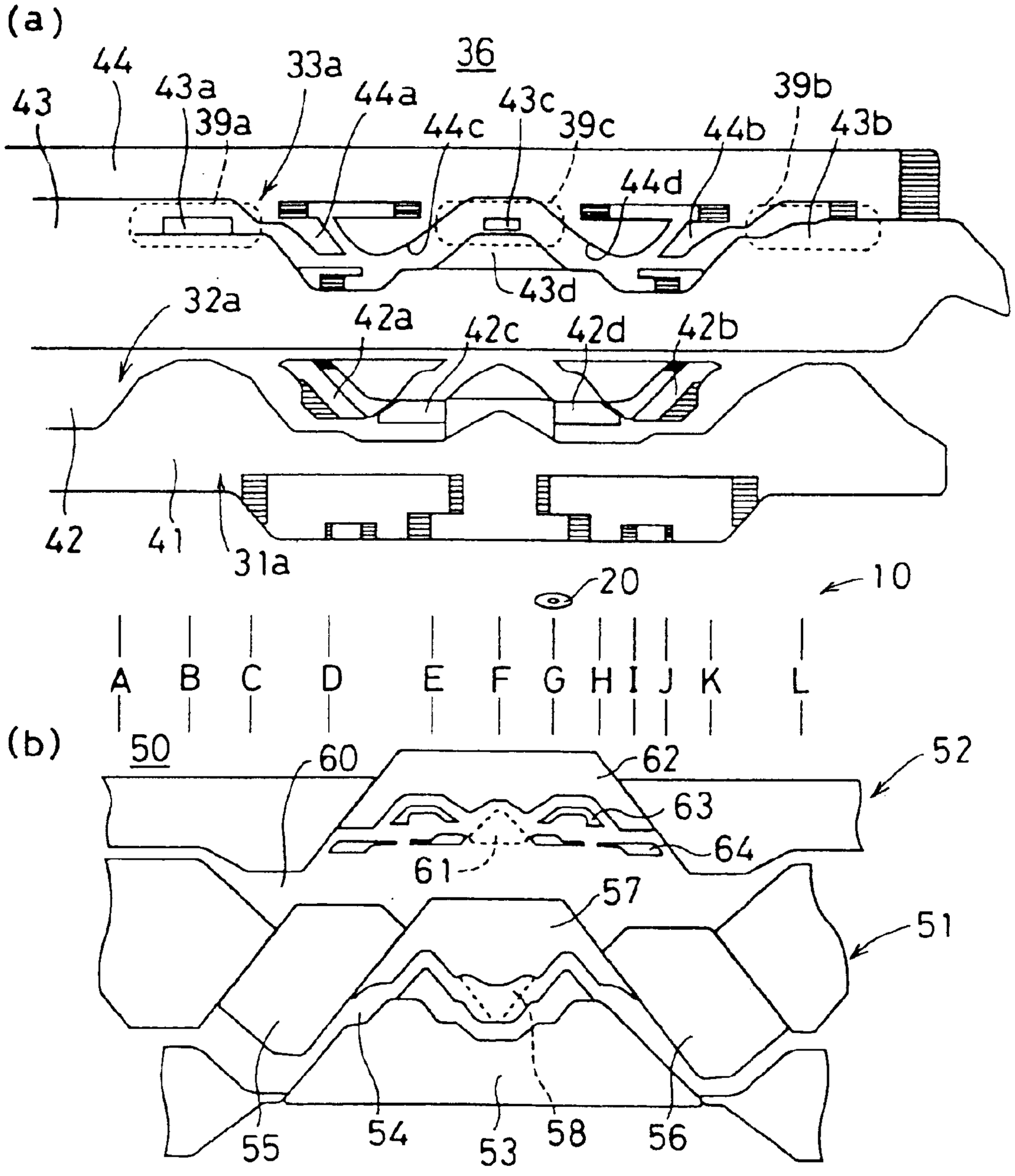


FIG. 4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39a
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44a
44c
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39c
44b
39b
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44d
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42a
42c
42d
42b
42
41
31a
20
10
A
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C
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(b)
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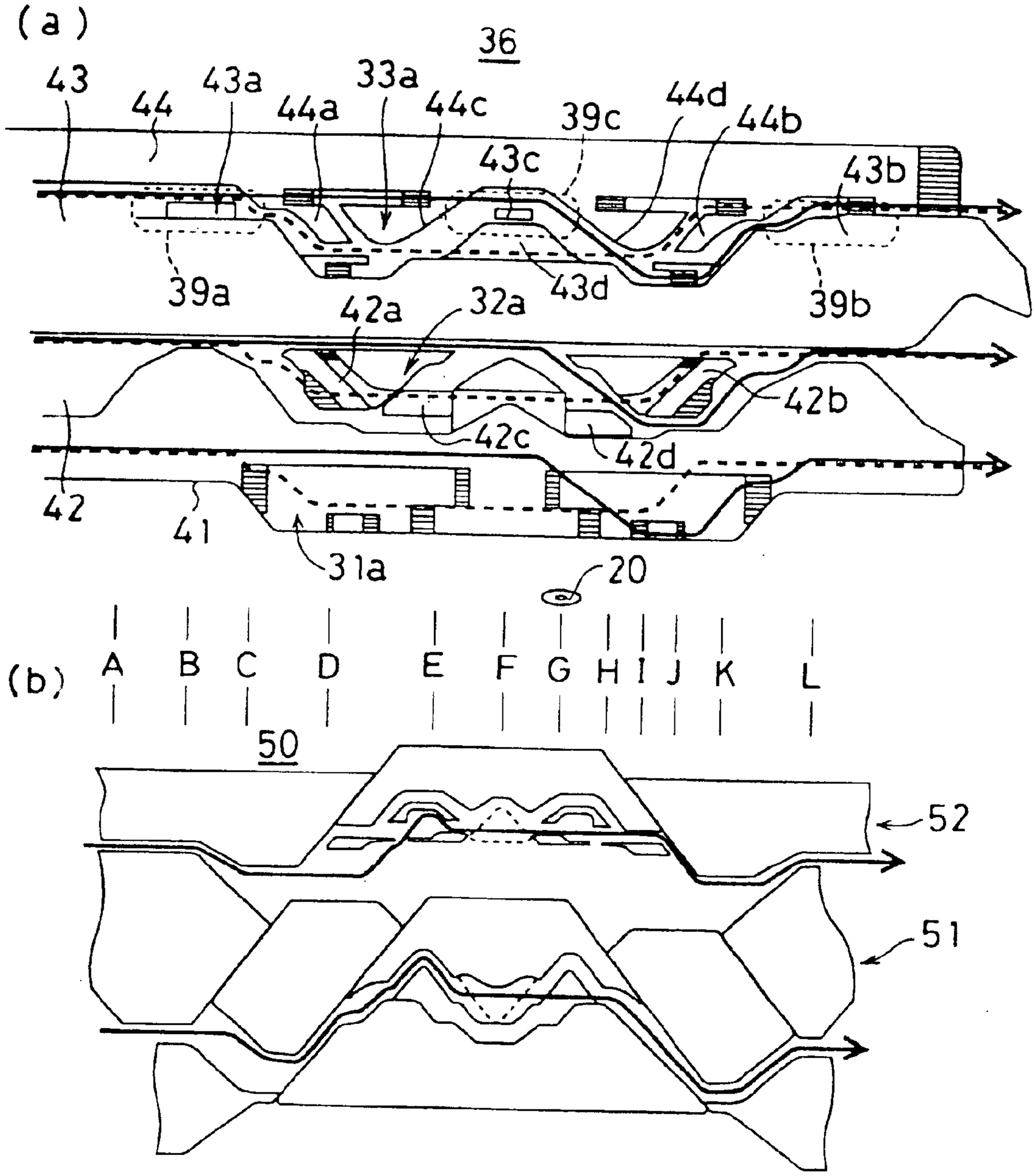
FIG. 5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42c
42d
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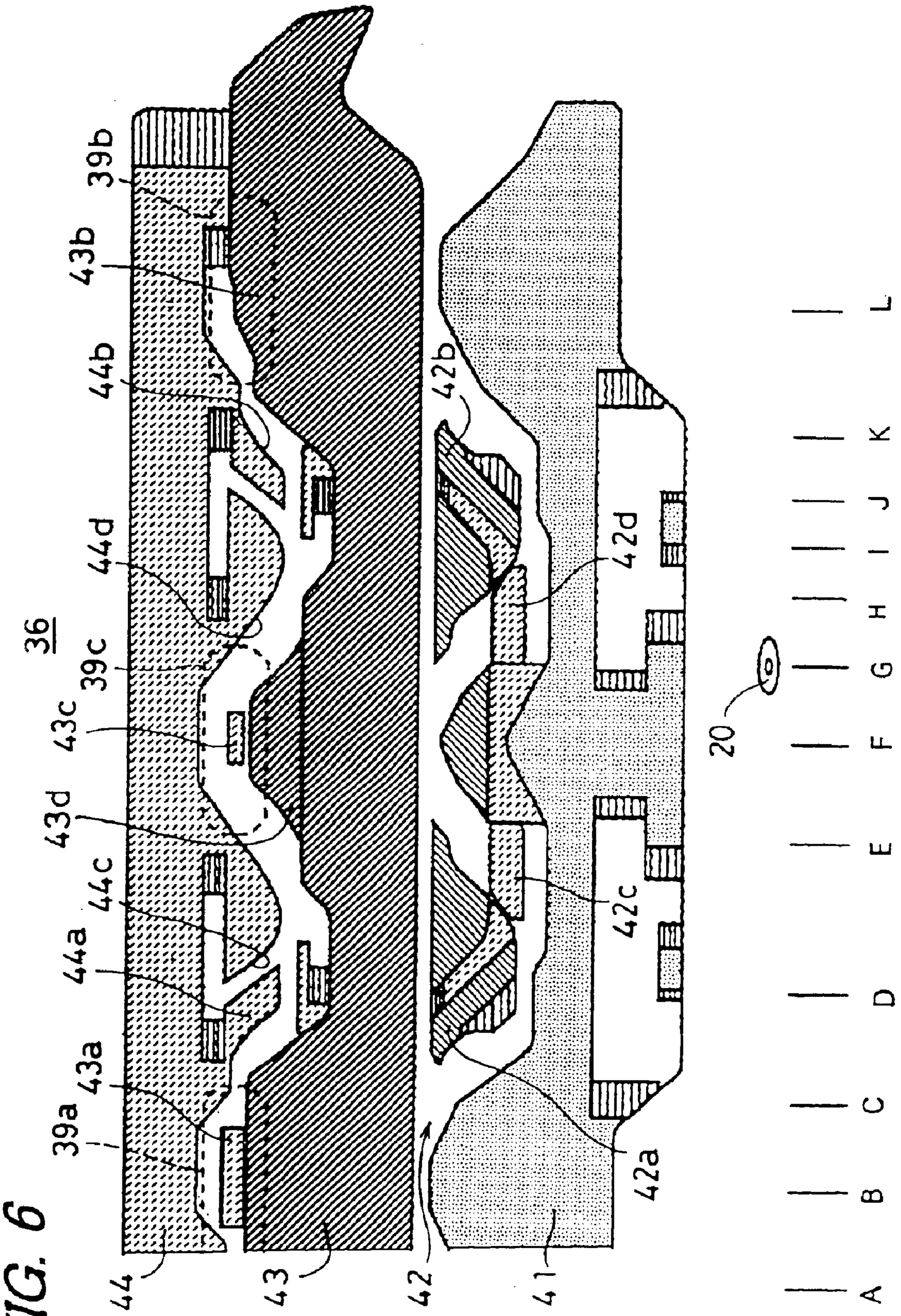
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FIG. 6

FIG. 7

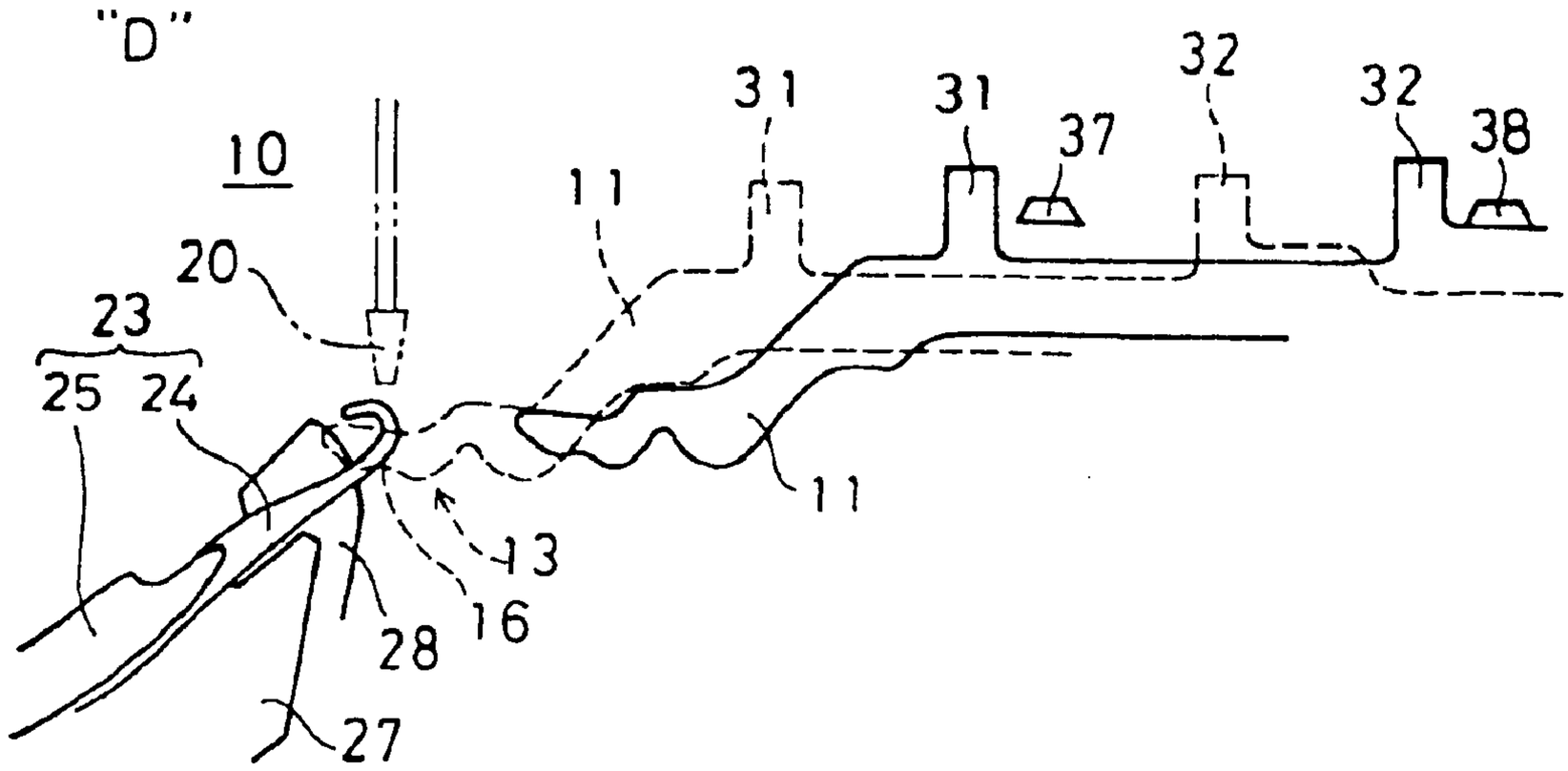
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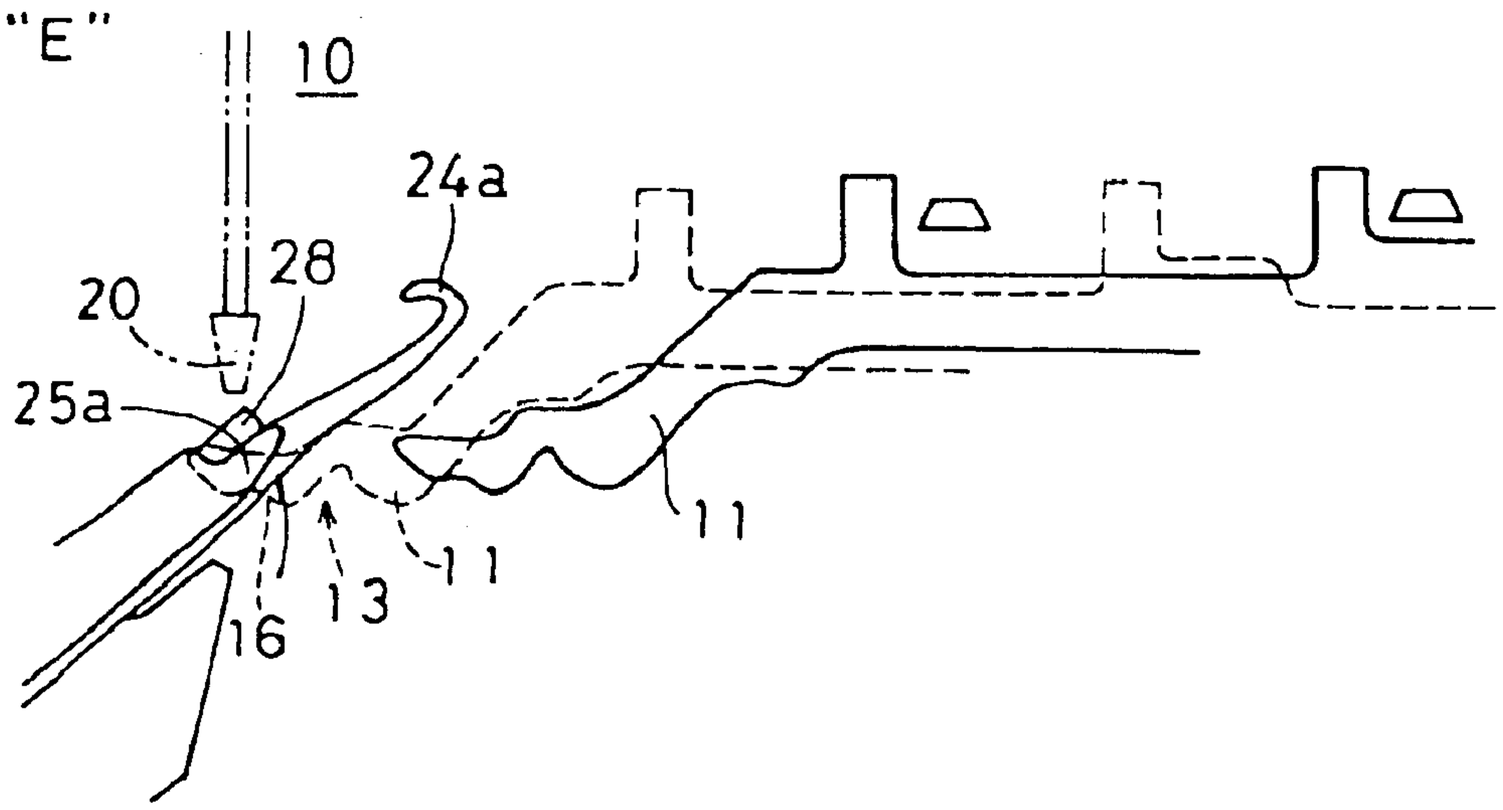
FIG. 8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16

FIG. 9

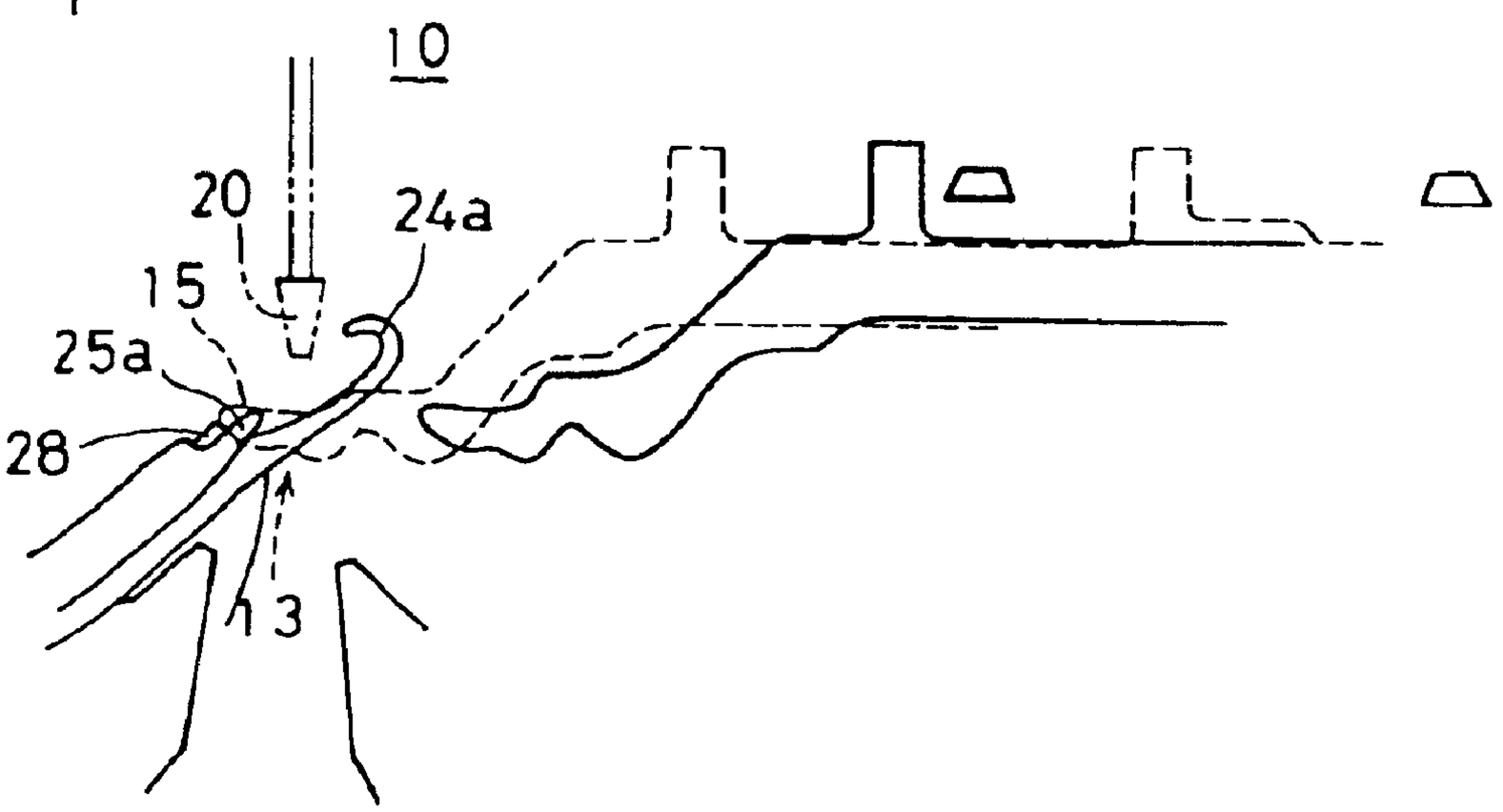

FIG. 10

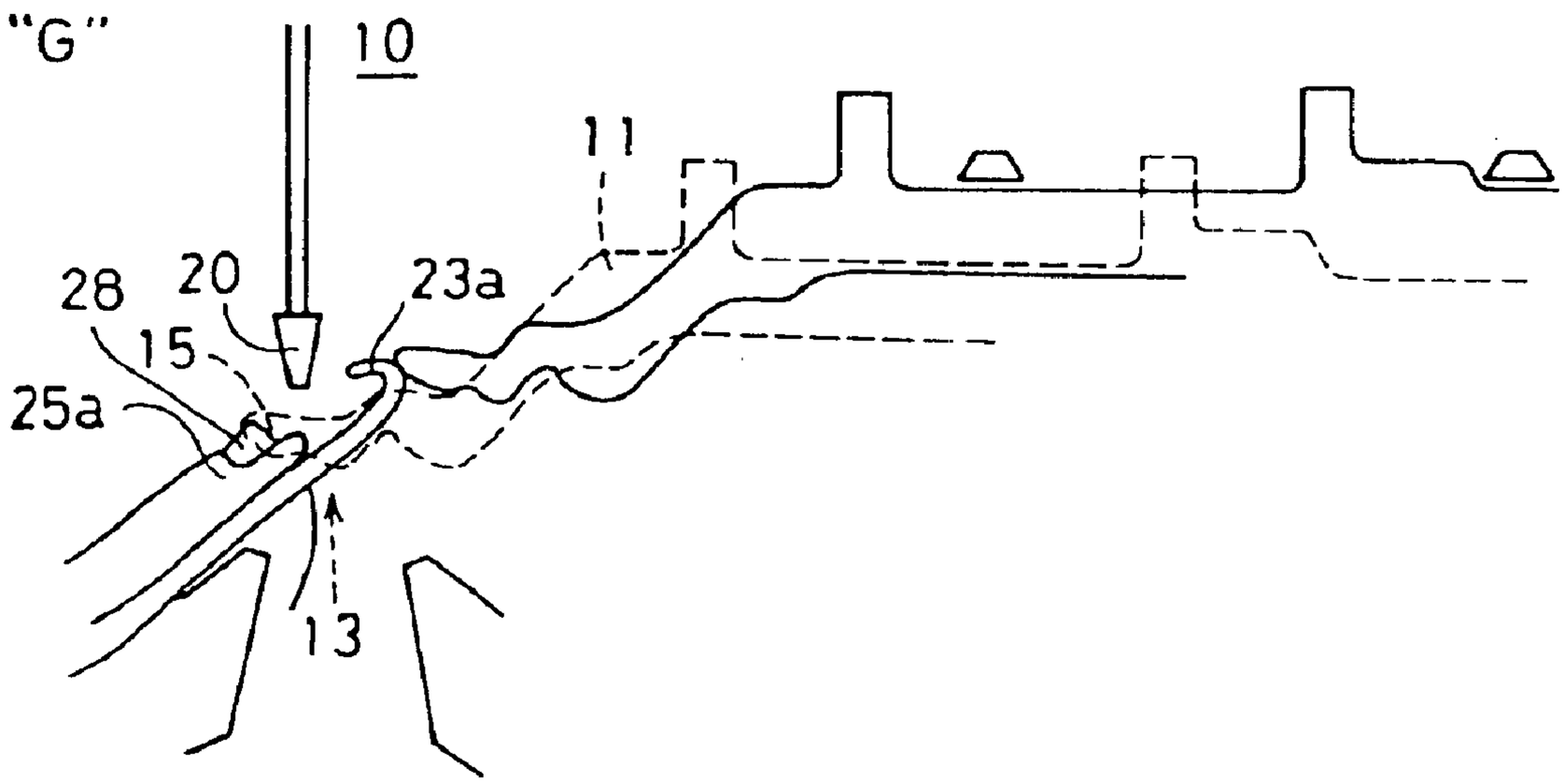

FIG. 11

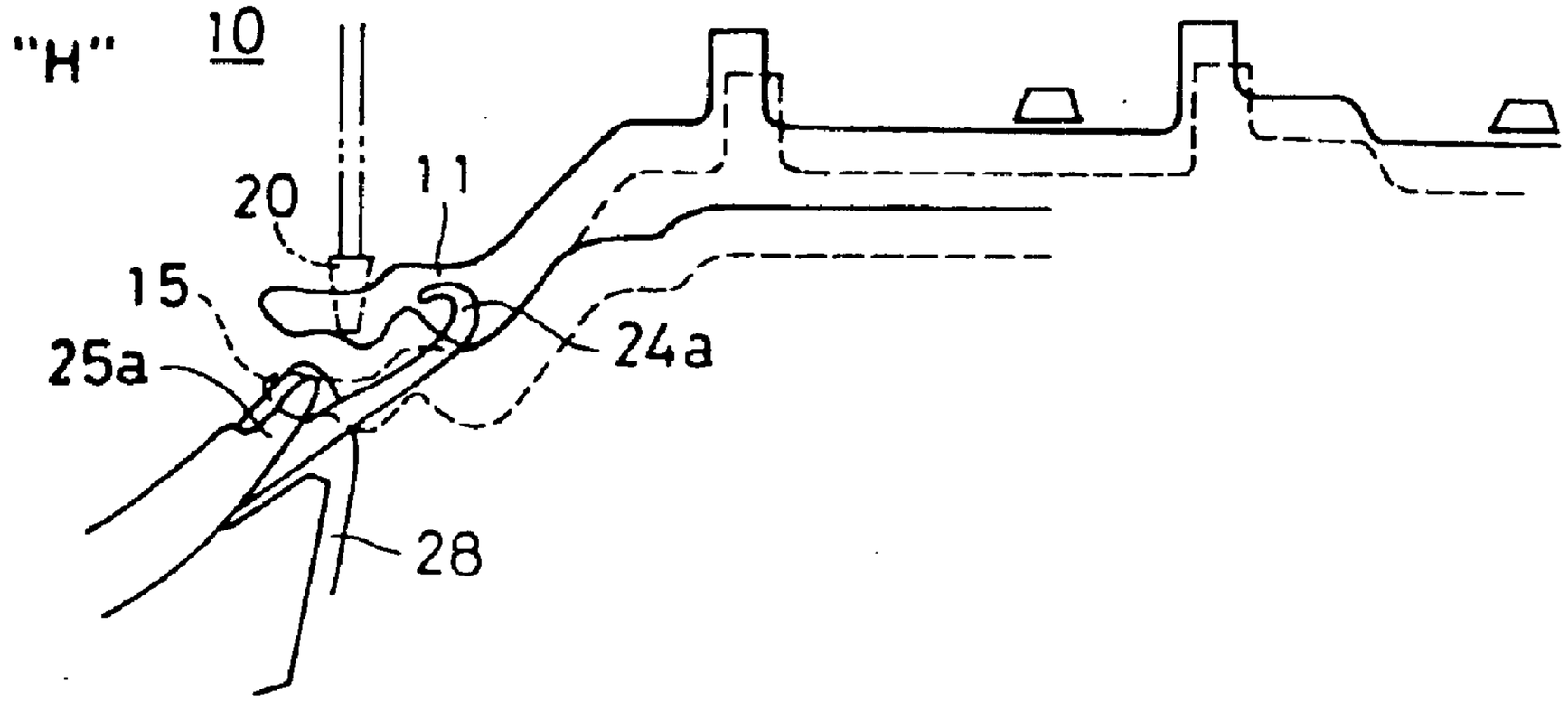

FIG. 12

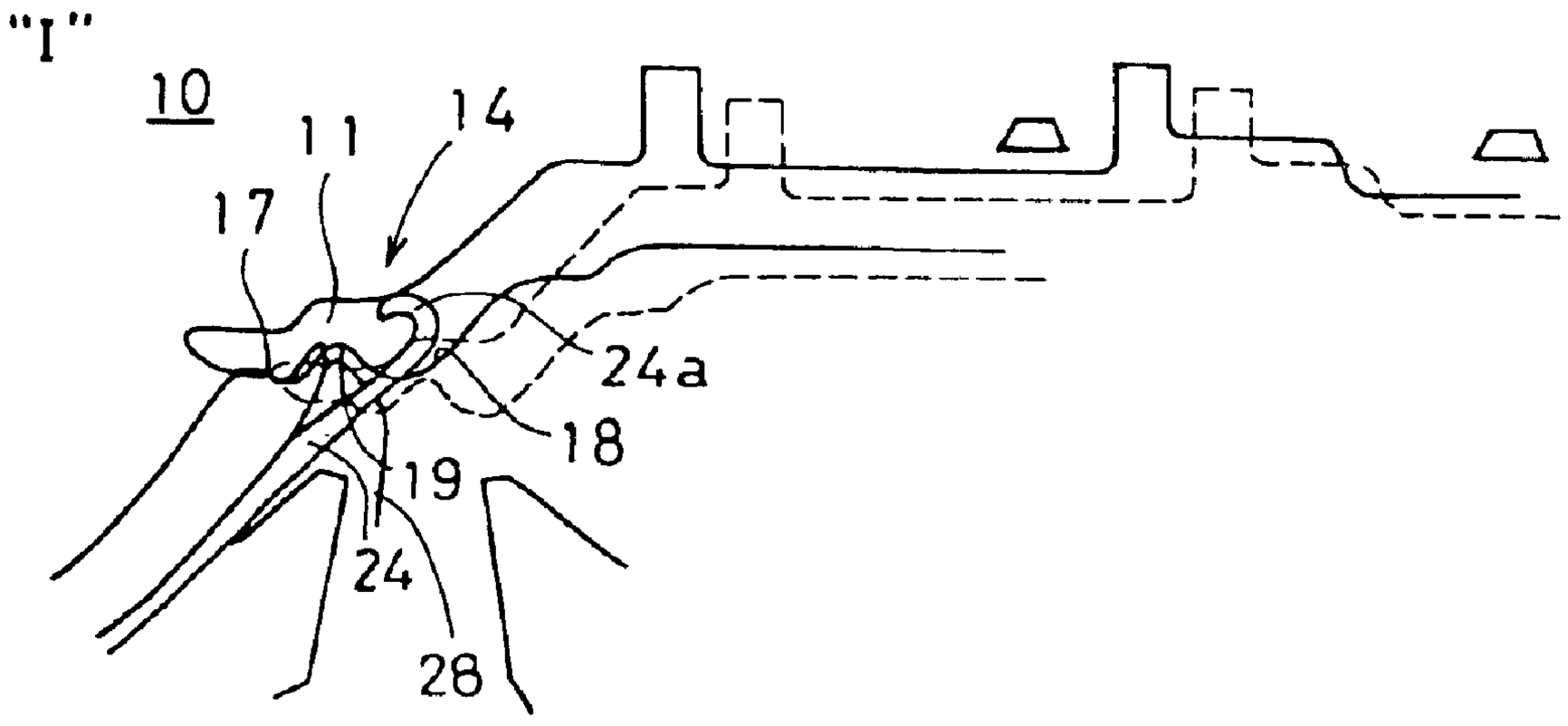

FIG. 13

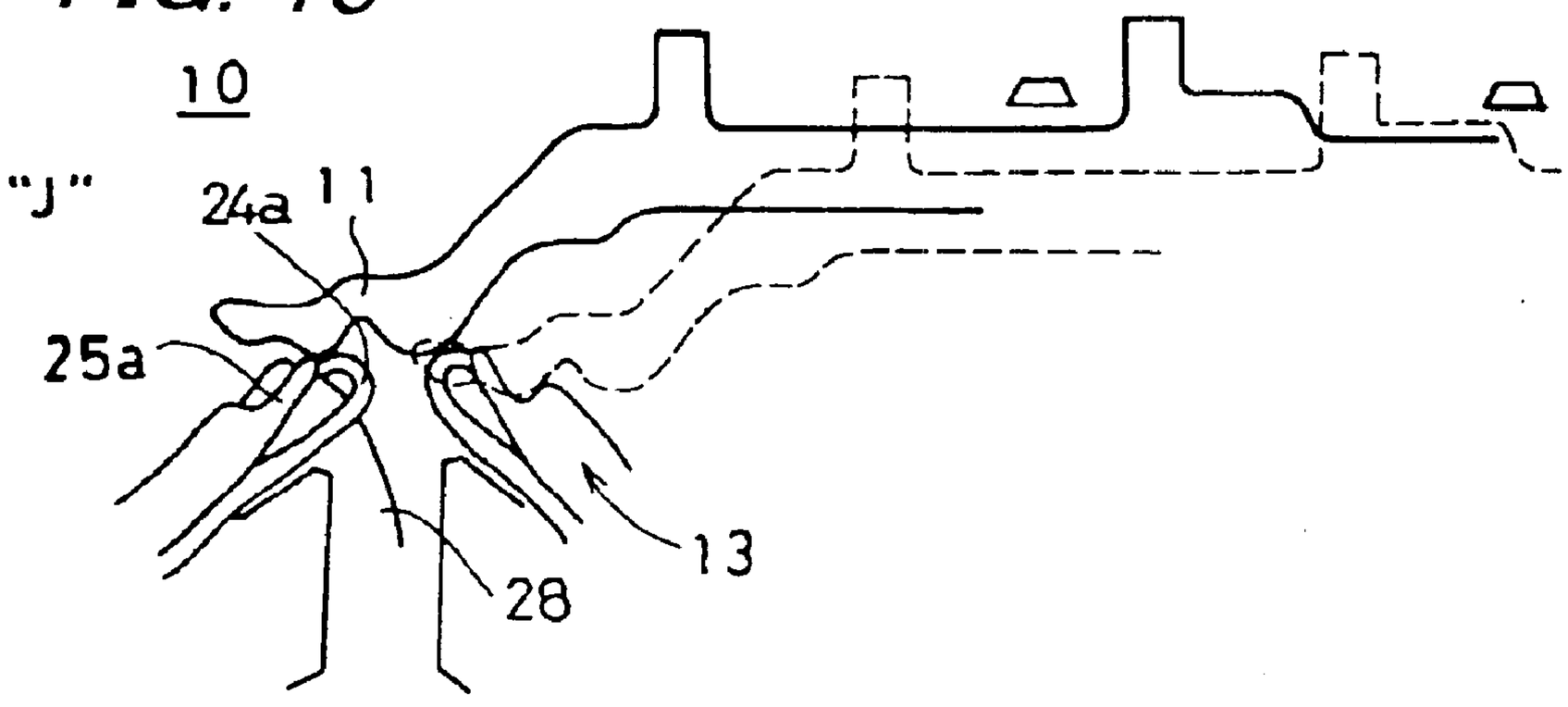

FIG. 14

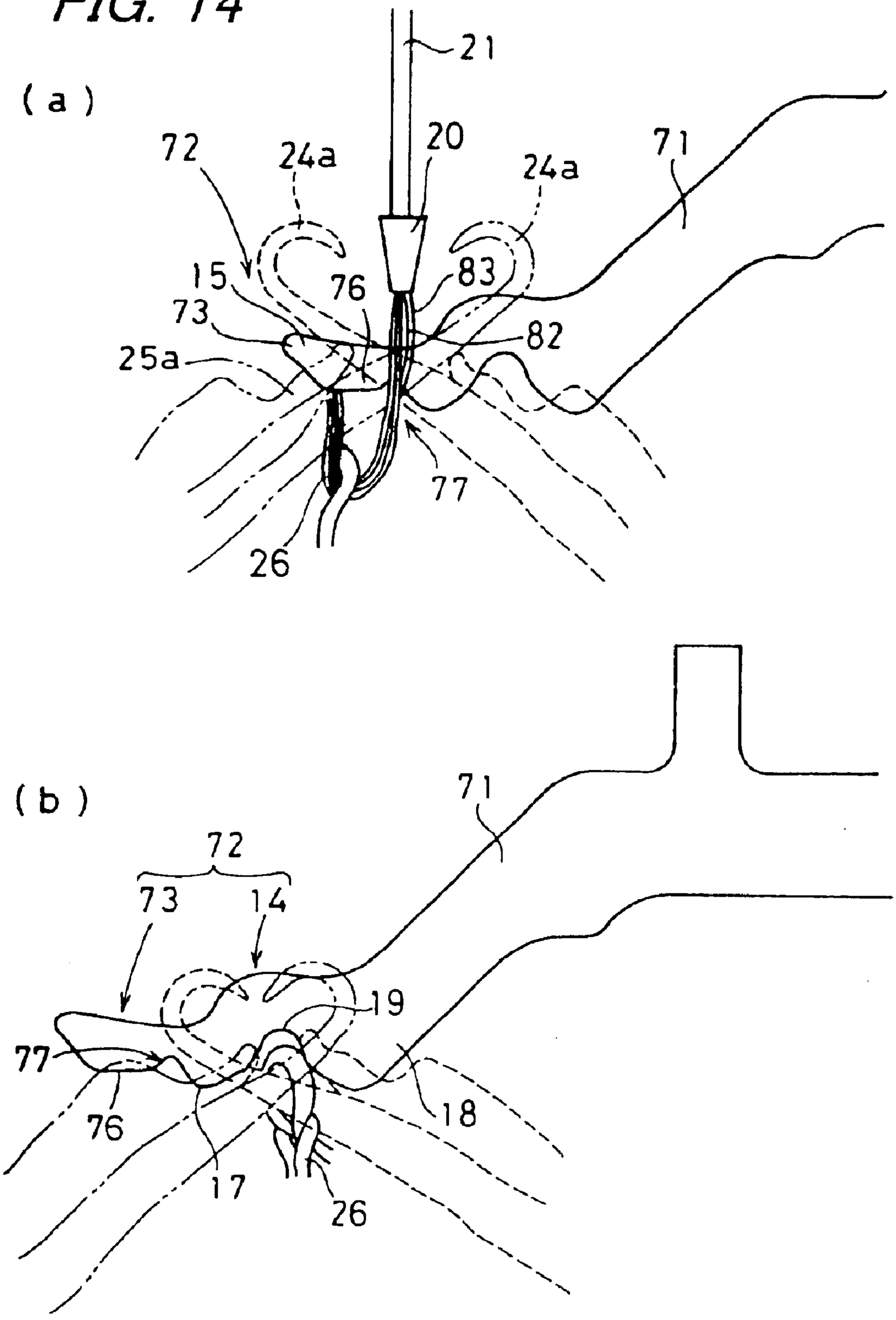
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FIG. 15

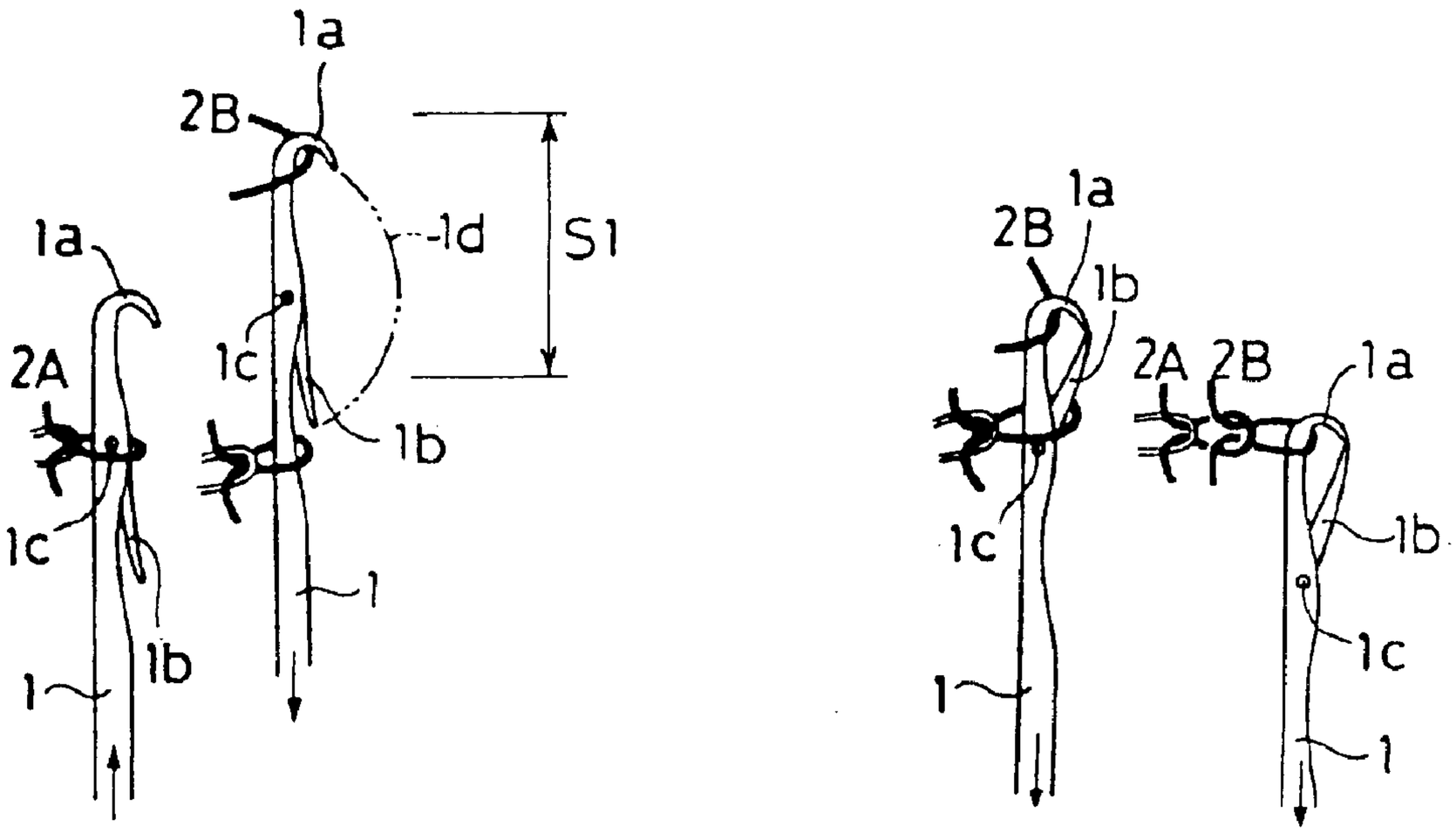
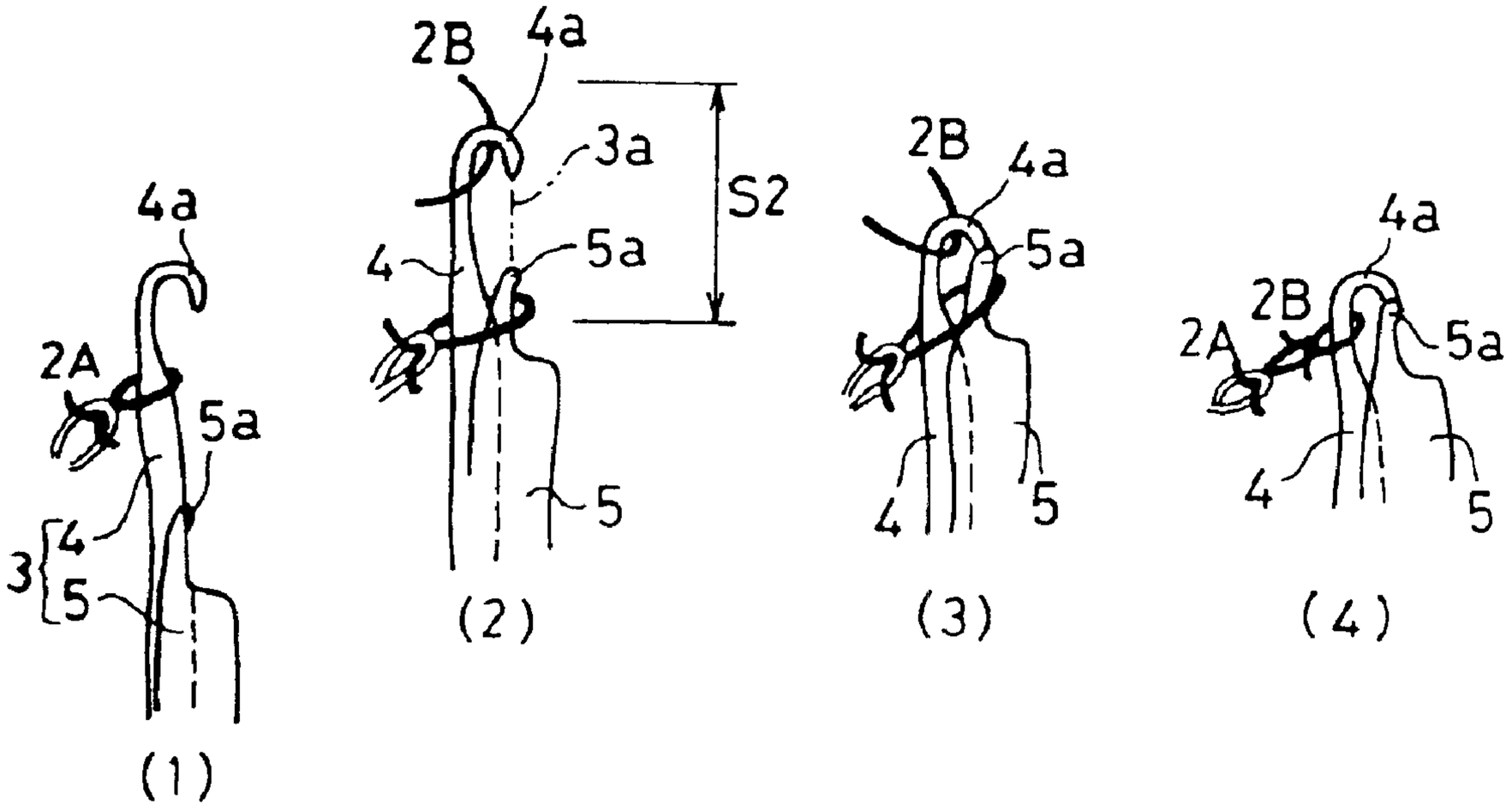


FIG. 16



LOOP PRESSER, FLATBED KNITTING MACHINE HAVING LOOP PRESSER, AND FABRIC KNITTING METHOD USING LOOP PRESSER

TECHNICAL FIELD

The present invention relates to a loop presser that presses a knitting stitch loop during knitting with a flat knitting machine, a flat knitting machine provided with the loop presser and a method for making a knitted fabric using the loop presser.

BACKGROUND ART

Conventionally in a flat knitting machine, a latch needle **1** as shown in FIG. **15** is used as a basic knitting needle. The latch needle **1** has a hook **1***a* at the top, and a knitting operation is performed in which a knitting stitch loop is formed while opening or closing the hook **1***a* by swinging and displacing the latch **1***b* with a rivet **1***c* as its center.

FIG. **15(1)** shows a state in which after a ready-made knitting stitch loop **2**A is formed with a knitting yarn, the latch needle **1** is lifted so that the latch **1***b* is opened by the knitting stitch loop **2**A from an inner side of the hook **1***a*. FIG. **15(2)** shows a state in which the latch needle **1** is lifted to the uppermost position, and an old knitting stitch loop **2**A is moved so as to be positioned lower than the latch **1***b*, and then the latch needle **1** starts to come down, and a knitting yarn is supplied to the hook **1***a* to form a new knitting stitch loop **2**B. FIG. **15(3)** shows a state in which the latch needle **1** has come down, and the latch **1***b* is closed by the knitting stitch loop **2**A when the latch **1***b* has passed through the portion of the old knitting stitch loop **2**A. FIG. **15(4)** shows a state in which the latch needle **1** reaches the lowermost position, and the old knitting stitch loop **2**A passes from the closed latch **1***b* to the outside of the hook **1***a* and a knockover is generated, and thus a new knitting stitch loop **2**B is formed.

In the basic knitting with the latch needle **1**, the operations **(1)** to **(4)** are repeated. Therefore, it is necessary to move the latch needle upward and downward by a stroke **S1** between the uppermost position where the hook **1***a* is higher than the state shown in **(2)** and the lowermost position shown in **(4)**. The top of the latch **1***b* draws a locus **1***d* shown in FIG. **15(2)**, so that when a knitting yarn is supplied inside the locus **1***d*, a knitting stitch loop can be formed between the hook **1***a* and the latch **1***b* when the latch **1***b* is closed as shown in FIG. **15(3)**.

In a flat knitting machine, a compound needle **3** as shown in FIG. **16** is used as well. The compound needle **3** serves as a knitting needle, using a needle main body **4** and a slider **5**. A hook **4***a* is formed on the top of the needle main body **4**, and a tongue **5***a* is formed on the top of the slider. The needle main body **4** and the slider **5** can move independently in the vertical direction of the drawing, and the relative movement of the slider **5** with respect to the needle main body **4** can open and close the hook **4***a* with the tongue **5***a*. The configuration of the flat knitting machine using such a compound needle **3** is disclosed in Japanese Patent No. 3085657 by the applicant.

FIG. **16(1)** shows the state in which after a ready-made knitting stitch loop **2**A is formed with a knitting yarn, the needle main body **4** is lifted, and the hook **4***a* is apart from the tongue **5***a* of the slider **5** so that the needle hook for holding the knitting stitch loop **2**A is opened. FIG. **16(2)** shows a state in which the needle main body **4** is lifted to the uppermost position, and an old knitting stitch loop **2**A is moved so as to be positioned in the tongue **5***a*, and then the needle main body **4** starts to come down, and a knitting yarn is supplied to the hook **4***a* to form a new knitting stitch loop **2**B. FIG. **16(3)** shows a state in which the needle main body **4** has come down, the tongue **5***a* holds the old knitting stitch loop **2**A and the needle hook is closed. FIG. **16(4)** shows a state in which the needle main body **4** and the slider **5** reach the lowermost position, and the old knitting stitch loop **2**A passes from the closed tongue **5***a* to the outside of the hook **4***a* and a knockover is generated, and thus a new knitting stitch loop **2**B is formed.

In the case of a flat knitting machine having the compound needle **3**, the movement of the slider **5** having the tongue **5***a* on its top that is apart from or in contact with the hook **4***a* to open or close the needle hook does not draw the locus **1***d* of arc movement such as the latch **1***b* of the latch needle **1**, but draws a linear locus **3***a*. Therefore, an advance and retreat stroke **S2** of the needle main body **4** can be small, so that the size of the flat knitting machine can be reduced and high productivity can be obtained.

In order to increase the productivity with the flat knitting machine, a loop presser that presses knitting stitch loops during knitting can be used. The applicant discloses the configuration of a flat knitting machine in which a loop presser is mounted in Japanese Patent No. 3044373. FIGS. **5** to **8** of this patent publication disclose the configuration in which a loop presser for pressing a knitting stitch loop latched by a latched needle and a yarn guide for pressing down a knitting yarn suspended from a yarn feeding port to the latch needle with a yarn pressing portion and guiding the knitting yarn to a position at which the hook of the latch needle can hold the knitting yarn are provided. FIGS. **13** and **14** disclose the configuration in which a loop pressing portion of the loop presser is advanced to a side end portion of a knitted fabric, and end stitches are made while the knitting yarn extending from the last formed knitting stitch loop to the yarn feeding port is pressed. Such a function can be regarded as a yarn guiding function for the end stitches. Furthermore, FIG. **15** and the following drawings disclose the configuration in which the yarn guiding function also is served by a loop presser as a "best mode example". In this best mode example, one loop presser presses a knitting stitch loop and feeds a yarn to the hook, and even in the case of the compound needle, stable yarn feeding conditions can be obtained.

As described above, in the compound needle **3**, as shown in FIG. **16**, the necessary stroke is smaller than in the latch needle **1** shown in FIG. **15**, so that the productivity can be increased. However, opening/closing the hook **4***a* of the compound needle **3** is performed by the movement that draws the linear locus **3***a* as described above, and therefore the yarn feeding conditions are stricter than in the latch needle **1**. When the best mode example disclosed in Japanese Patent No. 3044373 is used, it is expected that stable yarn feeding conditions can be obtained even for the compound needle.

The yarn guiding function for end stitches disclosed in Japanese Patent No. 3044373 is performed using the same portion of the top portion of the loop presser as used for the loop pressing function. It is not particularly considered to make a portion exclusively for the yarn guiding function for end stitches. The carriage that controls the knitting movement of the knitting needle is provided with a plurality of sets of systems constituted by cam locks, and when the carriage travels once in a longitudinal direction of a knitting bed, a plurality of courses can be knitted. It is selected in one

needle selecting portion provided corresponding to each system for knitting whether or not the loop presser is to be operated, and the cam route in which the loop presser passes is controlled by a solenoid, so that switching whether only the loop pressing function is operated or the loop pressing function and the yarn guiding function are operated is performed. For this reason, the loop presser used during knitting one course passes always in the same cam route.

In a case where a knitted fabric is knitted with the compound needle, the following problem may be caused. In the side end portion of the knitted fabric that becomes a folded portion of the knitted fabric, the knitting yarn is surmounted on the slider of the knitting needle when feeding the yarn to the knitting needle for the start of knitting for the next course, and this knitting yarn cannot be held by the needle hook (hereinafter, this problem is referred to as "yarn entanglement"). The problem of yarn entanglement in end stitches may be caused by the following factors.

The position of the knitting yarn at the time of feeding the yarn is not precisely determined partly because the position of the yarn feeding port provided on the top of the yarn carrier is not appropriately adjusted, or the yarn carrier does not work due to a long time use. In a case where so-called multiple yarn knitting using bundled knitting yarns is performed, the knitting yarn is particularly easily surmounted on the slider, because the knitting yarn is flattened and extended at the point when the knitting yarn is in contact with the knitting needle. Furthermore, when the tension applied to the knitting yarn is weak, the knitting yarn is easily dislocated and easily surmounted on the slider. The problem is caused especially when the knitting needle for knitting at the end of the course is the same needle that for knitting at the start of the next course such as plain stitch or rib stitch.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a loop presser that can improve the yarn feeding conditions to a knitting needle and improve the loop pressing function and the yarn guiding function to end stitches in a flat knitting machine provided with a compound needle including a needle main body and a slider as a knitting needle, a flat knitting machine provided with the loop presser and a method for making a knitted fabric using the loop presser.

It is another object of the invention to provide a loop presser that can prevent the problem of yarn entanglement in which a knitting yarn is surmounted on the slider with a knitting needle for end stitches and can guide the knitting yarn into the needle hook when a compound needle is used by switching with needle selection patterns or the like, a flat knitting machine provided with the loop presser and a method for making a knitted fabric using the loop presser.

The invention provides a loop presser in a flat knitting machine comprising at least a pair of needle beds in the front and the back in which a tooth mouth is formed such that the front and back needle beds are opposed to each other in a form of an angle such that top sides are oriented upward. A compound needle is provided in each needle bed as a knitting needle, in a process of making a knitting yarn fed from a yarn feeding port traveling in a longitudinal direction of the needle bed above the tooth mouth into a knitting stitch loop to form a knitted fabric that is suspended downward, the loop presser being capable of advancing and retracting its top portion from an auxiliary bed supported on at least one of the front and back needle beds with respect to the tooth mouth and having a function of pressing the knitting stitch loop that is made. The top portion is in different positions in the advancing and retracting direction a loop presser portion having the function of guiding the knitting yarn fed from the yarn feeding port to the knitting needle and pressing the knitting stitch loop between the knitting needles on a lower side. A knitting yarn holding portion for end stitches serves a function of holding a knitting yarn fed from above the tooth mouth in the outside of a knitting end of a knitted fabric in a width direction. The knitting yarn holding portion has a pressing portion for pressing the knitting yarn suspended from the knitting stitch loop held by the compound needle in the knitting end to the yarn feeding port moving toward the outside of the knitted fabric on the lower side, and a wall portion preventing the knitting yarn fed from the yarn feeding port moving toward the inside of the knitted fabric by reversing the moving direction to the compound needle in the knitting end from approaching a tongue top in a state where a hook is open on an upper side.

The invention is characterized in that the knitting yarn holding portion is nearer on a top side of the advancing and retracting direction than the loop presser portion.

The invention is characterized in that the knitting yarn holding portion has a recess on which a knitting yarn made of multiple yarns that are formed with a bundle of a plurality of fine yarns are converged on its lower side.

Furthermore, the invention provides a flat knitting machine comprising the loop presser of any one of the above-described loop pressers. A loop presser mechanism advances to and retracts from the top portion according to a predetermined locus so as to guide the knitting yarn fed from the yarn feeding port passing through a position of the compound needle for making a knitted fabric to a position where the knitting yarn can be held by a hook of the compound needle and press a knitting stitch loop which is knitted by the pressing portion. A knitting yarn holding mechanism for end stitches makes the knitting yarn hold so as to advance the knitting yarn holding portion to the tooth mouth on the side before the compound needle used at first in knitting in knitting a knitted end, reversing a traveling direction of a yarn and starting knitting a next course, presses the knitting yarn suspended from the compound needle in which the knitting end is knitted to the yarn feeding port on the lower side of the knitting yarn holding portion of the loop presser until the yarn feeding port passes through a position of the compound needle, and feeds the knitting yarn to the compound needle used at first in knitting from the upper side of the the knitting yarn holding portion. After the yarn feeding port passes through the compound needle used at first in knitting, the loop presser mechanism and the knitting yarn holding mechanism cooperate so as to prevent the knitting yarn fed to the compound needle used at first in knitting by guide by the loop presser portion of the loop presser that is advanced to and retracted from by the loop presser mechanism is prevented, from approaching a tongue top in a state where a hook is open by the wall portion on the upper side of the knitting yarn holding portion of the loop presser that is advanced to and retracted from by the knitting yarn holding mechanism.

The invention is characterized in that the auxiliary bed in which the loop presser advances and retracts is open downward on a base end side of the advancing and retracting direction. The loop presser has a butt projected upward the flat knitting machines further comprises a selecting mechanism that is opposed to the base end portion of the loop presser below the open portion of the auxiliary bed and attracts the base end portion and can release the attraction selectively. A cam mechanism has a function as the loop

presser mechanism or the knitting yarn holding mechanism selectively, in which a cam groove that is engaged with the butt above the auxiliary bed and drives the butt to be displaced in the advancing and retracting direction is formed. The cam mechanism can switch to the function either as the loop presser mechanism or the knitting yarn holding mechanism by selecting the cam groove engaged with the butt by releasing attraction to the base end portion of the loop presser with the selecting mechanism.

The invention is characterized in that the cam groove of the cam mechanism has generally a symmetrical shape with respect to a central line parallel to the advancing and retracting direction of the loop presser so that the top portion of the loop presser draws the same locus at the time of knitting on one side of the longitudinal direction of a needle bed as that at the time of knitting on the other side. The selecting mechanism is positioned in a position opposed to the central line of the cam mechanism and positions that are the same distance away from the position opposed to the central line on one side and the other side of the needle bed.

Furthermore, the invention provides a method for making a knitted fabric using a loop presser in a flat knitting machine comprising at least a pair of needle beds in the front and the back in which a tooth mouth is formed such that the front and the back needle beds are opposed to each other in a form of an angle such that top sides are oriented upward. A compound needle is provided in each needle bed as a knitting needle, in a process of making a knitting yarn fed from a yarn feeding port traveling in a longitudinal direction of the needle bed above the tooth mouth into a knitting stitch loop to form a knitted fabric that is suspended downward. The loop presser is capable of advancing and retracting its top portion from an auxiliary bed supported on at least one of the front and back needle beds with respect to the tooth mouth and has a function of pressing the knitting stitch loop that is made. The method comprises forming in the top portion of the loop presser in different positions in the advancing and retracting direction, a portion having the function of guiding the knitting yarn fed from the yarn feeding port to a position where the knitting yarn can be held by a hook of the compound needle and pressing the knitting stitch loop between the knitting needles on the lower side, and a portion serving a knitting yarn holding function for end stitches of holding a knitting yarn fed from above the tooth mouth in the outside of a knitting end of a knitted fabric in the width direction,

switching the loop presser function or the knitting yarn holding function by switching the position to which the top portion of the loop presser is advanced to the tooth mouth,

making the knitting yarn hold so as to advance the portion serving the knitting yarn holding function in the top portion of the loop presser to the tooth mouth on the side before the compound needle used at first in knitting in knitting a knitted end, reversing a traveling direction of a yarn and starting knitting a next course, pressing the knitting yarn suspended from the compound needle in which the knitting end is knitted to the yarn feeding port on the lower side of the portion serving the knitting yarn holding function until the yarn feeding port passes through a position of the compound need, and feeding the knitting yarn to the compound needle used at first in knitting from the upper side of the portion serving the the knitting yarn holding function, and

after the yarn feeding port passes through the compound needle used at first in knitting, making the loop presser cooperate so as to advance another loop presser to the tooth mouth and prevent the knitting yarn fed to the compound needle used at first in knitting by guide by the portion serving the loop presser function, from approaching a tongue top in a state where a hook is open by an upper side of the loop presser that advances the portion serving the knitting yarn holding function to the tooth mouth serving as a wall.

The invention is characterized in that the portion serving the knitting yarn holding function has a recess on the lower side, and knitting is performed while converging a knitting yarn made of multiple yarns that are formed with a bundle of a plurality of fine yarns on the recess.

BRIEF DESCRIPTION OF THE DRAWINGS

Other and further objects, features, and advantages of the invention will be more explicit from the following detailed description taken with reference to the drawings wherein:

FIG. **1** is a partial side view showing a state in which a function is switched between a function of holding a knitting yarn for end stitches and a loop presser function with a loop presser **11** that is one embodiment of the invention;

FIG. **2** is a partial cross sectional side view showing a schematic configuration of a flat knitting machine using the loop presser **11** of this embodiment;

FIG. **3** is a side view showing the contour of the loop presser **11** of this embodiment;

FIG. **4** is a sight-through view showing the configurations of a cam mechanism **36** for operating the loop presser **11** and a compound needle **23** and a cam mechanism **50** for knitting in this embodiment;

FIG. **5** is a sight-through view showing loci of the traveling of the butts of the loop presser **11** and the compound needle **23** in this embodiment;

FIG. **6** is a simplified plan view showing the height of a cam plane in the cam mechanism **36** in this embodiment;

FIG. **7** is a view showing an advance state of the loop presser **11** at the position D of FIGS. **4** to **6**;

FIG. **8** is a view showing an advance state of the loop presser **11** at the position E of FIGS. **4** to **6**;

FIG. **9** is a view showing an advance state of the loop presser **11** at the position F of FIGS. **4** to **6**;

FIG. **10** is a view showing an advance state of the loop presser **11** at the position G of FIGS. **4** to **6**;

FIG. **11** is a view showing an advance state of the loop presser **11** at the position H of FIGS. **4** to **6**;

FIG. **12** is a view showing an advance state of the loop presser **11** at the position I of FIGS. **4** to **6**;

FIG. **13** is a view showing an advance state of the loop presser **11** at the position J of FIGS. **4** to **6**;

FIG. **14** is a partial side view showing the state in which a function is switched between a function of holding a knitting yarn for end stitches and a loop presser function with a loop presser **71** that is another embodiment of the invention;

FIG. **15** is a view showing a knitting operation with a latch needle; and

FIG. **16** is a view showing a knitting operation with a compound needle.

BEST MODE FOR CARRYING OUT THE INVENTION

Now referring to the drawings, preferred embodiments of the invention are described below.

FIG. **1** shows a shape of a top portion **12** of a loop presser **11** that is advanced in a tooth mouth **10** of a flat knitting machine that is one embodiment of the invention. The loop presser **11** is formed of a metal plate, and in the top portion **12**, a knitting yarn holding portion **13** for end stitches and a loop presser portion **14** are provided in different positions. The loop presser **11** can advance and retract the top portion **12** to the tooth mouth **10**. Regarding the advancing and retracting direction, the knitting yarn holding portion **13** for end stitches is provided nearer to the end side than a loop presser portion **14**.

FIG. **1**(*a*) shows a state in which the knitting yarn holding portion **13** for end stitches is positioned in the tooth mouth **10**, and FIG. **1**(*b*) shows a state in which the loop presser portion **14** is positioned in the tooth mouth **10**. The knitting yarn holding portion **13** for end stitches has a shape including a wall portion **15** on an upper side and a pressing portion **16** on a lower side. The loop presser portion **14** has a shape including two loop pressing portions **17** and **18** on the lower side and a yarn guide portion **19** therebetween.

As shown in FIG. **1**(*a*), above the tooth mouth **10**, a yarn feeding port **20** is provided in the top of the yarn carrier **21** to feed a knitting yarn **22** to the tooth mouth **10**. The tooth mouth **10** is opposed to the top of front and back needle beds provided in the flat knitting machine. Each needle bed is inclined such that the side of the tooth mouth **10** is lifted, and the side shape is an angle. In each needle bed, compound needles **23** are arranged as multiple knitting needles. The compound needle **23** of one of the front and the back needle beds is shown by an alternate long and short dash line, and the compound needle **23** of the other needle beds is shown by a broken line. In each needle bed, the compound needle **23** is reciprocated and displaced in a needle groove formed in a predetermined pitch to advance and retract its top side to the tooth mouth **10**. The compound needle **23** is basically the same as the compound needle **3** shown in FIG. **16**, and is constituted by a needle main body **24** and a slider **25**. A hook **24***a* is formed on the top of the needle main body **24**, and a tongue **25***a* is formed on the top of the slider **25**.

FIG. **1**(*a*) shows a state in which the compound needle **23** shown by the alternate long and short dash line reaches an end stitch, the yarn carrier **21** is moved from a far side of the drawing to a nearer side, a knitting stitch loop **26** in one course is made, knitting in the next course is started, and the knitting yarn holding portion **13** for end stitches of the loop presser **11** is advanced onto the nearer side than the compound needle **23**. When the yarn feeding port **20** is still positioned before the knitting yarn holding portion **13**, the knitting yarn **22** suspended from the knitting stitch loop **26** to the yarn feeding port **20** is pressed at a contact point **16***a* that establishes contact with the pressing portion **16**. When the yarn carrier **21** is moved from the nearer side to the far side while keeping the advance state of the knitting yarn holding portion **13** for end stitches, the knitting yarn **22** is turned back by the knitting yarn holding portion **13** for end stitches, and brought in contact with the wall portion **15** at a contact point **15***a* and held. The knitting yarn **22** is pulled back to the far side with the movement of the yarn feeding port **20**, and fed to the hook **24***a* for knitting in the next course. Thus, the process in the knitting end as shown in FIG. **13** of Japanese Patent No. 3044373 can be performed. Furthermore, in this embodiment, the top of the tongue **25***a* of the compound needle **23** is not projected beyond the wall portion **15** of the knitting yarn holding portion **13** for end stitches, and therefore the problem of yarn entanglement such as a situation where the knitting yarn **22** is surmounted on the tongue **25***a* of the slider **25** can be prevented. On the side farther than the knitting needle **23** for end stitches, the yarn guide portion **16** of the loop presser portion **14** is engaged with the knitting yarn **22** fed from the yarn feeding port **20** to the knitting needle **23** for end stitches so as to guide the yarn to the hook **24***a*.

As shown in FIG. **1**(*b*), the loop presser portion **14** of the loop presser **11** has a shape including the loop pressing portions **17** and **18** for pressing the knitting stitch loop **26** made with the compound needles **23** of the front and back needle beds in the lower portion. The loop pressing portions **17** and **18** are on a slant face that is substantially perpendicular to the moving direction of the compound needle **23** advancing from the front and back needle beds, and the yarn guide portion **19** is formed in a recess therebetween. The yarn guide portion **19** has a function of reliably guiding the knitting yarn **22** fed from the yarn feeding port **20** to the hook **24***a*. The operation and the function of the loop presser that has two functions of the loop presser function and the yarn guiding function are basically the same as those in the loop presser described as a "best mode example" in the paragraphs [0066] to [0089] with reference to FIGS. **15** to **21** in Japanese Patent No. 3044373 in which a flat knitting machine using a latch needle is specifically described.

FIG. **2** shows a simplified configuration in longitudinal section of a flat knitting machine using the loop presser **11** of FIG. **1**. In the tooth mouth **10**, at least one pair of front and back needle beds **27** is arranged linear-symmetrically with respect to a phantom central line **10***a* such that the head portions are opposed to each other at an angle. Three or more needle beds **27** can be provided. In each needle bed **27**, a needle groove for guiding is formed so that the compound needle **23** can advance to and retract from the tooth mouth **10**, and a sinker **28** for supporting a knitting yarn when the compound needle **23** draws the knitting yarn is provided along the needle groove on a head portion of each needle groove. An auxiliary bed **29** is provided above at least one of the front and back needle beds, for example, above the back needle bed, and a groove **30** for guiding the movement with which the loop presser **11** advances and retracts its top portion **12** to the tooth mouth **10** is formed. An arrangement pitch of the loop presser **11** corresponds to an arrangement pitch of the compound needle **23** in the needle bed **27**. However, these arrangement pitches do not necessarily have to have one-to-one relation, but the pitch can be such that one loop presser **11** corresponds to a plurality of compound needles **23**. The compound needle **23** and the loop presser **11** are displaced so as to advance to and retract from the tooth mouth **10** by a cam mechanism that is mounted on a carriage that can reciprocate in the longitudinal direction of the needle bed **27**, that is, in the direction perpendicular to the sheet surface.

FIG. **3** shows a shape of the loop presser **11**. In addition to the knitting yarn holding portion **13** for end stitches and the loop presser portion **14** in the top portion **12**, as described above, the loop presser **11** has a shape in which a plurality of butts such as a first butt **31**, a second butt **32** and a third butt **33** are projected upward over a portion from the front portion to the tooth mouth **10** to a rear portion apart from the tooth mouth **10**. An elastic arm **34** that is branched from a front portion extends on a lower side of a middle portion of the loop presser **11**. A base end portion **35** is provided in the rearmost portion of the loop presser **11**. The bottom face of the base end portion **35** is flat. As shown in FIG. **3**(*a*), when the loop presser **11** is in a free state in which no external force is applied to the loop presser, the elastic arm **34** is opened downward. As shown in FIG. **2**, when the loop presser **11** is accommodated in the groove **30** of the auxiliary

bed **29**, an upper side of the loop presser **11** is in contact with the cam mechanism **36** and metal bands **37** and **38**, and the lower side is in contact with the bottom face of the groove **30**, so that the elastic arm **34** is bent by elastic deformation as shown by the broken line in FIG. **3**(*b*).

As shown in FIG. **2**, in the auxiliary bed **29**, the rear portion of the groove **30** is open, and the base end portion **35** of the loop presser **11** is exposed from an open portion when the top portion **12** of the loop presser **11** is retreated from the tooth mouth **10**. A selecting mechanism **39** for switching the function of the loop presser **11** utilizing magnetic force is provided below the open portion of the auxiliary bed **29**. The base end portion **35** is urged to be apart from the surface of the selecting mechanism **39** by a resilient force of the elastic arm **34**. When the cam mechanism **36** presses the third butt **33**, the base end portion **35** comes down against the resilient force of the elastic arm **34**, and the surface is attracted to the selecting mechanism **39** by the magnetic force. The selecting mechanism **39** has a permanent magnet and an electromagnet. When current flows through the electromagnet, an attracting force of the permanent magnet is cancelled, so that the base end portion **35** attracted by the permanent magnet is released. If current does not flow through the electromagnet, the base end portion **35** continues to be attracted in the range in which the base end portion **35** is in contact with the selecting mechanism **39**.

FIG. **4**(*a*) shows a sight-through state of the cam mechanism **36** shown in FIG. **2** in such a manner that the lower side corresponds to a side of the tooth mouth **10**. FIG. **4**(*b*) shows a sight-through state of a knitting cam mechanism for advancing and retracting the compound needle **23** in such a manner that the upper side corresponds to the side of the tooth mouth **10**. FIG. **5**(*a*) shows passage loci of the first butt **31**, the second butt **32**, and the third butt **33** of the loop presser **11**, and FIG. **5**(*b*) shows passage loci of the compound needles. FIG. **6** shows the difference in the height of each portion of the cam mechanism **36** from the substrate. In FIGS. **4**(*a*), **5**(*a*) and **6**, the hatched portion with parallel horizontal lines is an inclined surface. Reference numerals A, B, C, D, E, F, G, H, I, J, K, and L denote the positions referred to in the description below, in particular, reference numeral F indicates a central position and reference numeral G is a yarn feeding position from the yarn feeding port **20**. The side of the tooth mouth corresponds to the lower portion of the drawings, but the operation of advancing the loop presser **11** to the side of the tooth mouth is referred to as "lifting", and the operation of retreating it from the side of the tooth mouth is referred to as "lowering".

As shown in FIG. **4**(*a*), the cam mechanism **36** is generally provided with a first guide cam **41**, a second guide cam **42**, a third guide cam **43** and a fourth guide cam **44**. A first cam track **31***a*, a second cam track **32***a*, and a third cam track **33***a* for acting on the first butt **31**, the second butt **32** and the third butt **33** of the loop presser **11** are formed between the first guide cam **41** and the second guide cam **42**, between the second guide cam **42** and the third guide cam **43**, and between the third guide cam **43** and the fourth guide cam **44**, respectively. Each guide cam is generally linear symmetrical in the horizontal direction of FIG. **4**(*a*), and when the carriage travels in a reciprocating movement, the same action can be performed.

Hereinafter, the invention will be described, assuming that the carriage in which the cam mechanism **36** is mounted moves from the left to the right of the drawing. The selecting mechanism **39** is provided in three portions along the third cam track **33***a*. The selecting mechanism **39***a* on the leading side and the selecting mechanism **39***b* on the trailing side are provided in a symmetrical positions with respect to the center, and when the moving direction becomes opposite so that the carriages moves from the right to the left, the selecting mechanism **39***b* is on the leading side. A selecting mechanism **39***c* is provided in the center, and has a common function with respect to the reciprocating movement of the carriage. Along the second cam track **32***a*, lowering cams **42***a* and **42***b* that are urged by a spring to be projected from the substrate of the cam mechanism **36** are provided in symmetrical positions with respect to the center. Furthermore, pressing cams **42***c* and **42***d* that are urged by a spring to the direction away from the tooth mouth **10** are provided in symmetrical positions with respect to the center. Regarding the third cam track **33***a*, pressing projected portion **43***a*, **43***b* and **43***c* for pressing the third butt **33** of the loop presser **11** so that the base end portion **35** is attracted to the selecting mechanisms **39***a*, **39***b* and **39***c*, respectively, are provided. Furthermore, a projecting/retreating cam **43***d* whose surface can be projected and retreated from the substrate is provided in the central portion of the third guide cam **43**. The fourth guide cam **44** is provided with lifting cams **44***a* and **44***b* serving to hold a knitting yarn for end stitches that advance the loop presser **11** by being engaged with the third butt **33**, and lifting cams **44***c* and **44***d* serving as a loop presser.

FIG. **4**(*b*) shows a schematic configuration of a knitting cam mechanism **50**. The knitting cam mechanism **50** is constituted by a needle main body cam lock **51** and a slider operation cam lock **52**. The needle main body cam lock **51** includes a raising cam **53** having a double hump shape, a pair of stitch cams **55** and **56** provided on both sides of the raising cam **53** so as to sandwich a butt path **54** for allowing passage of a butt provided in the needle main body **24** shown in FIGS. **1** and **2**, and a bridge cam **57** disposed on the side of the tooth mouth **10** of the raising cam **53**, and a transfer control cam **58** provided between the two humps of the raising cam **53**. The raising cam **53** and the bridge cam **57** are formed as fixed cams. The stitch cams **55** and **56** can be displaced along a slant face in which they are in contact with the bridge cam **57** so that the size of the knitting stitch loop **26** to be knitted can be adjusted. The transfer control cam **58** can be switched so as to be projected or retreated. When it is projected, the hook **24***a* of the needle main body **24** is displaced to the position retracted farther from the tooth mouth **10** than a far end position of the knit state serving as the basis when knitting is performed, and a transfer operation in which the knitting stitch loop **26** is moved between the opposing needle beds.

The slider operation cam lock **52** includes a transfer control cam **61** that can be switched so as to be projected or retreated and fixed slider guide cams **62**, **63**, and **64** along a butt path **60** that allows the passage of the butt for advancement. When the transfer control cam **61** is projected, the tongue **25***a* of the slider **25** is advanced farther beyond the position of the hook **24***a* that is retreated as described above to the side of the opposing needle bed **27**, and a transfer operation can be performed. Such a compound needle **23** is basically the same as that specifically described in Japanese Patent No. 3085657.

As shown in FIG. **5**(*a*), the passage locus of each butt of the loop presser **11** when forming knitting stitches while the carriage is traveling to the right direction can be switched between the path shown by a broken line in which the knitting yarn holding portion **13** for end stitches functions, which can be obtained by operating the selecting mechanism **39***a*, and the path shown by a solid line in which the loop

presser portion **14** functions, which can be obtained by operating the selecting mechanism **39***c*. The projecting/retreating cam **43***d* of the third guide cam **43** is set to be in the retreated state in which the surface is not projected. In the path shown by the broken line for the function of holding the knitting yarn for end stitches, in the third cam track **33***a*, the third butt **33** is guided by the lifting cam **44***a* in the positions corresponding to C to D, and the loop presser **11** is lifted to the side of the tooth mouth **10**. Since the projecting/retreating cam **43***d* is retreated, the third butt **33** can pass above the projecting/retreating cam **43***d*. In the second cam track **32***a*, when the second butt **32** surmounts the lowering cam **42***a* in the position corresponding to D, the lowering cam **42***a* is retreated so as to be in the same height as the pressing cams **42***c* and **42***d* or the like, so that the second butt **32** is suppressed from going up all the way to the vicinity of the position corresponding to I. The pressing cam **42***d* keeps its position that is symmetrical with the pressing cam **42***c* with respect to the central line by being urged by a spring, as shown in FIG. **4**(*a*). FIG. **5**(*a*) shows the state after the second butt **32** moved the position of the pressing cam **42***d* in the loop presser function as described later. In the third cam track **33***a*, after the position corresponding to I, the lowering cam **42***b* acts on the third butt **33** so as to move the loop presser **11** in the direction away from the tooth mouth **10**.

In the path shown by the solid line for the function as the loop presser, the lifting cam **44***d* of the fourth guide cam **44** guides the third butt **33** in the positions corresponding to G to H, and the top of the lowering cam **42***b* guides the second butt **32** after the position corresponding to I so that the loop presser **11** can be advanced farther to the side of the tooth mouth than the path for serving the function of holding a knitting yarn for end stitches. When the second butt **32** passes by the position of the pressing cam **42***d*, as shown in FIG. **5**(*a*), the pressing cam **42***d*, urged by a spring upward in FIG. **5**(*a*), can be moved downward by the front edge of the second butt **32** so as to obtain a passage.

FIG. **5**(*b*) shows the passage locus when knitting operation is performed with the compound needle **23** in the knitting cam mechanism **50**. When the releasing operation is not performed either in the selecting mechanism **39***a* or **39***b*, the loop presser **11** does not advance to the tooth mouth **10** and stays in a rest position.

As shown in FIG. **6**, a difference in the height from the substrate is provided on the cam surface of the cam mechanism **36**. The surface in which the density of filling shown by hatching with oblique lines or halftone dots is high is positioned higher than the substrate surface that is blank. However, as described above, the portion hatched with parallel horizontal lines is an inclined surface. The third guide cam **43** that is hatched with oblique solid lines descending to the right is the highest. The fourth guide cam **44** that is hatched with oblique broken lines descending to the right is lower than the third guide cam **43**. The first guide cam **41** that is filled with halftone dots is lower than the fourth guide cam **44**. The second guide cam **42**, hatched with oblique lines ascending to the right in the state where the lowering cams **42***a* and **42***b* are projected, is the second highest after the third guide cam **43**, and higher than the other cams including pressing cams **42***c* and **42***d* of the second guide cam **42**. The other cams, such as the pressing cams **42***c* and **42***d* of the second guide cam **42**, are equal to the fourth guide cam **44**. Regarding the projecting/retreating cam **43***d* of the third guide cam **43**, the state in which it is projected from the substrate surface, and its height from the substrate surface is highest, as the other portions of the third guide cam **43**. Thus, when the projecting/retreating cam **43***d* is projected, the loop presser **11** that once is lifted can be returned in the center.

As described above, in the locus for the function of holding a knitting yarn for end stitches, when the second butt **32** is surmounted on the surface of the lowering cam **42***a* from the inclined surface in the position corresponding to D, the lowering cam **42***a* sinks until its height becomes equal to the pressing cams **42***c* and **42***d* or the fourth guide cam **44**. The second butt **32** continues to be pressed at the surface of the same height such as the pressing cams **42***c* and **42***d* until it reaches the position corresponding to I. When the second butt **32** reaches the position corresponding to I, the second butt is in contact with the cam surface of the lowering cam **42***b* that is arranged symmetrically with the lowering cam **42***a*. The height in the state where the lowering cam **42***b* is projected is higher than the pressing cam **42***c* or the like, so that the second butt **32** in contact with the cam surface is guided along the cam surface and retreated from the tooth mouth side.

FIGS. **7**, **8**, **9**, **10**, **11**, **12** and **13** show the state in which the loop presser **11** is advanced to the tooth mouth **10** in the positions D, E, F, G, H, I and J shown in FIGS. **4** to **6**, respectively. The broken lines show the state in which the function of holding a knitting yarn for end stitches is served, and the solid lines show the state in which the loop presser function is served. The configuration in the vicinity of the tooth mouth **10** is based on the configuration of FIG. **2**, which is simplified in the drawings for convenience. Moreover, the knitting yarns and knitting stitch loops are omitted, and the positional relationship in which the top portion of the loop presser **11** is advanced to the tooth mouth **10** is mainly shown. FIG. **1**(*a*) corresponds to FIG. **10** at the position G, and FIG. **1**(*b*) corresponds to FIG. **12** at the position I. Hereinafter, the invention will be described with reference to FIGS. **2** to **13**. The loop presser **11** for which the path for serving the function of holding a knitting yarn for end stitches is selected is referred to as "end LP" for convenience, and the loop presser **11** for which the path for serving the loop presser function is selected is referred to as "knit LP" for convenience. The rest position of the end LP and the knit LP is the position in which each butt is in the uppermost position in FIG. **5**(*a*).

Position A (Before Reaching the Knitting Cam)

End LP rest position

knit LP rest position

needle rest position.

In this position, the surface to be attracted of the base end portion **35** of the loop presser **11** is positioned in the open portion of the rear portion of the auxiliary bed **29**. The upper surface of the main portion on the rear side of the second butt **32** is in contact with the metal band **38** provided in the auxiliary bed **29** so that the elastic arm **34** is compressed and deformed and the elastic arm **34** is pressed downward. The base end portion **35** of the loop presser **11** is urged by the resilient force to be projected upward.

Position B (Selecting Mechanism **39***a* is Attracted)

End LP rest position

knit LP rest position

needle rest position.

The third butt **33** of the loop presser **11** is pressed by the pressing projecting portion **43***a*, which is a presser for the third butt integrally formed with the fourth guide cam **44**. At this time, the first butt **31** is in contact with the surface of the first guide cam **41**, the loop presser **11** is swung in the counterclockwise direction with the contact portion of the

first butt and the first guide cam **41** as the swinging pivot point and the surface to be attracted of the base end portion **35** is in contact with the attraction surface of the selecting mechanism **39***a* provided on the leading side, and attracted.

Position C (After Passing the Leading Selecting Mechanism **39***a*)

End LP a little advanced

knit LP rest position

needle rest position.

After the position B, the surface to be attracted of the base end portion **35** reaches the magnetic pole portion while being attracted to the selecting mechanism **39***a*, and the base end portion **35** of the end LP whose attraction is cut off there is swung upward by the resilient force of the elastic arm **34**. Therefore, the third butt **33** is projected from the surface of the auxiliary bed **29**, and engaged with the lifting cam surface of the lifting cam **44***a* of the fourth guide cam **44** so that the loop presser starts to advance to the tooth mouth **10**. The loop pressers **11** other than the loop presser **11** selected as the end LP move straight in a lateral direction in the state where the base end portion **35** is attracted and held by the attraction surface of the selecting mechanism **39***a*. When the end LP advances, the contact between the metal band **38** and the upper edge of the end LP is cut off, and the first butt **31** enters the recess of the first guide cam **41** and is released from the pressing by the cam surface, so that the main portion of the end LP is pushed upward by the resilient force of the elastic arm **34**, but the end LP holds its position in the groove **30** while the upper surface of the base end portion **35** is in contact with the surface of the fourth guide cam **44**, and the upper surface of the main portion between the first butt **31** and the second butt **32** is in contact with the metal band **37** by pressure.

Position D (First Inclined Surface of the Raising Cam **53**)

End LP advanced position

knit LP rest position

needle a little advanced.

The third butt **33** of the end LP is guided up to the top portion of the lifting cam surface of the lifting cam **44***a* of the fourth guide cam **44**, the end of the knitting yarn holding portion **13** for end stitches traverses the sinker **28** of the opposing needle bed **27** when viewed from the side, as shown in FIG. **7**, and the gap of the tooth mouth **10** is closed. The second butt **32** is subjected to its presser function at the potion of the lowering cam **42***a*, which is a projecting/retreating cam (raising cam) for the second butt provided in the rear of the second guide cam **42**. The pressing portion **16** on the lower side of the knitting yarn holding portion **13** for end stitches presses a knitting yarn suspended from a knitting stitch loop held by the compound needle **23** to the yarn feeding port **20**. The end LP advances up to the position H while keeping the posture at the position D.

Position E (the Most Advanced Position of Knitting Needle)

End LP advanced position

knit LP rest position

needle the most advanced position (top of the raising cam **53**).

As shown in FIG. **8**, the hook **24***a* and tongue **25***a* are lifted to the most advanced position. The knitting stitch loop is held in a shoulder portion of the tongue **25***a*, and a suspended knitting yarn is pressed by the pressing portion **16** of the knitting yarn holding portion **13** for end stitches reliably.

Position F (Lower Position at the Bridge Cam **57**)

End LP advanced position

knit LP rest position

needle as high as the fed yarn.

As shown in FIG. **9**, the hook **24***a* and tongue **25***a* are lowered and the hook **24***a* is as high as the fed yarn. The top of the tongue **25***a* is limited to be not above the wall portion **15**.

Position G (After Passing the Selecting Mechanism **39***c* in the Middle Row)

End LP advanced position

knit LP a little advanced

needle as high as the fed yarn.

As shown in FIG. **10**, the yarn feeding port **20** passes through. The top of the tongue **25***a* is hidden by the wall portion **15** of the end LP. The loop pressers **11** other than the end LP reaches the magnetic pole portion in the state where the surface to be attracted of the base end portion **35** is attracted to the selecting mechanism **39***c* provided in the middle row, and the third butt **33** of the knit LP whose attraction is cut off is projected from the surface of the auxiliary bed **29**, and starts to advance toward the tooth mouth **10**, engaging the cam surface of the lifting cam **44***d* of the fourth guide cam **44**.

Position H (Root Crossing Portion of the End LP and the Knit LP)

End LP advanced position

knit LP advanced to the middle

needle as high as the fed yarn.

As shown in FIG. **11**, the knit LP advances to the tooth mouth **10** and starts to serve as a yarn guide. As shown in FIG. **5**(*a*), the second butt **32** presses the pressing cam **42***c* from its side and moves it, which results in a locus in which it advances into the tooth mouth **10** beyond in the end LP.

Position I

End LP advanced position

knit LP advanced position

needle descending.

As shown in FIG. **12**, the needle main body **24** starts to descend at the lowering cam surface of the bridge cam **57**. The second butt **32** of the knit LP drives away the pressing cam **42***d* and is engaged with the top surface of the lowering cam **42***b* that took over so as to be guided to the cam top portion. A knitting yarn is guided to the advancing and retracting locus of the hook **24***a* with the yarn guide portion **19** of the loop presser portion **14**. The top of the tongue **25***a* is hidden so that the knitting yarn extending from the yarn feeding port **20** is not directly surmounted on the slider **25** by allowing the end LP to cooperate with the knit LP, that is, by the wall portion **15** of the end LP, and the knitting yarn above the slider **25** is moved to the advancing and retracting locus of the hook **24***a* near the center of the tooth mouth **10** by the yarn guide portion **19** in the knit LP while being in contact with the wall portion **15** of the end LP, so that the knitting yarn can be held by the needle hook reliably. The knitting stitch loop that is made is pressed by the loop pressing portions **17** and **18** of the knit LP, and the function as a loop presser which is the same as the conventional loop presser, can be served.

Position J (Position of an Inclined Surface of the Stitch Cam **56**)

End LP start to descend (the second butt **32** is engaged with the lowering cam surface of the lifting cam **42***b*)

knit LP advanced position

needle in the process of retracting with the stitch cam (the slider **25** also is descending).

As shown in FIG. **13**, the end LP retreats and releases the knitting yarn held by the knitting yarn holding portion **13** for end stitches.

Position K (Position of a Flat Portion of the Stitch Cam)

End LP rest position

knit LP start to descend

needle height for stitch determination (the third butt **33** is engaged with the lowering cam surface of the third guide cam **43**).

Position L (Position After Passing the Stitch Cam)

End LP rest position

knit LP rest position

needle rest position

FIG. **14** shows a shape of a top portion **72** of a loop presser **71** that is another embodiment of the invention. In this embodiment, the portions corresponding to those of the embodiment of FIG. **1** are denoted by the same reference numerals, and the duplicated description will be omitted. In this embodiment, as shown in FIG. **14**(*a*), a recess **77** is formed in a pressing portion **76** of a knitting yarn holding portion for end stitches **73**. Thus, even if a knitting yarn **82** made of multiple yarns in which a plurality of fine yarns **83** are bundled is used, they can be converged on the recess **77**, so that the problem of yarn entanglement can be prevented reliably. As shown in FIG. **14**(*b*), the function at the loop presser portion **14** is the same as that of the loop presser **11** shown in FIG. **1**(*b*).

In the embodiments described above, the knitting yarn holding portion **13** for end stitches and **73** are formed on the side of the top of the top portion **12** and **72** of the loop presser **11** and **71**, and the loop presser portion **14** is formed on the side of the base end. However, The knitting yarn holding portion for end stitches can be positioned on the side of the base end. However, when the same loop pressing portions **17** and **18** and the yarn guide portion **19** as those of the loop presser portion **14** of the embodiments of the invention are formed in the loop presser portion, it is preferable that the knitting yarn holding portion **13** and **73** for end stitches are positioned on the top side, because after the functions as the end LP as shown in FIGS. **7** to **13** are served, the loop presser can be easily pulled out from the held knitting stitch loop.

In the flat knitting machine provided with the loop presser of the invention, the selecting mechanisms **39***a*, **39***c* and **39***b* of the loop presser are provided in the leading, the middle and trailing rows, respectively, with respect to the traveling direction of the carriage. Therefore, for example, in the case of knitting a knitted fabric in which there is no need of considering the problem of yarn entanglement of end stitches, a loop presser corresponding to a knitting needle used for knitting in the leading selecting mechanism is selected, and the knitting needle advances to the tooth mouth **10**, the previous loop stopped by a needle hook is pressed so that the previous loop is not lifted with the advance movement of the needle main body **24** and it is guaranteed that the previous loop is cleared. In this case, the projecting/retreating cam **43***d* is set to the state where it is projected as shown in FIG. **6**. For example, in the case where the knitting operation to be performed is stitch transfer, the configuration can be such that the loop presser corresponding to the knitting needle that performs stitch transfer traces the same route as that of the end LP of the above embodiments. In the case where the knitting operation to be performed is involved in formation of a knitting stitch, of the loop pressers corresponding to the knitting needle used for knitting, odd numbered loop pressers are allowed to act using the leading selecting mechanism so that previous loops are prevented from being lifted together. Then, the remaining even numbered loop pressers are selected with the following middle selecting mechanism, so that the knitting yarn can be guided to the hook by the even numbered loop pressers.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and the range of equivalency of the claims are therefore intended to be embraced therein.

Industrial Application

As described above, according to the invention, the top portion of the loop presser has a loop presser portion serving a function of pressing the knitting stitch loop by advancing to a tooth mouth of a flat knitting machine and a knitting yarn holding portion for end stitches serving a function of holding a knitting yarn fed from above the tooth mouth in the outside of a knitting end of a knitted fabric in the width direction in different positions in the advancing and retracting direction. Therefore, the portion that acts on the tooth mouth is changed to obtain a shape for exclusive purpose for each function, so that each function can be improved.

In addition, the upper side of the knitting yarn holding portion for end stitches can be utilized as a wall portion preventing the knitting yarn fed from the yarn feeding port from approaching a tongue top in a state where a needle hook of the compound needle is open by making (1) the loop presser for holding the knitting yarn in the outside of the knitting end of the knitted fabric and (2) another loop presser for pressing the knitting stitch loop knitted by guiding the yarn fed from the yarn feeding port to the compound needle for knitting the knitted fabric cooperate. Therefore, when knitting a knitting stitch of a knitting end in the width direction of a knitted fabric, the knitting yarn can be guided in the hook such that the problem of yarn entanglement in which the knitting yarn is surmounted on the tongue of the slider and goes outside the hook can be prevented.

According to the invention, the knitting yarn holding portion for end stitches is formed nearer to the top of the advancing and retracting direction than the loop presser portion. Therefore, the loop presser portion can be larger than the yarn guide portion for end stitches, and the stiffness can be increased so that the knitting stitch loop can be pressed sufficiently.

According to the invention, the knitting yarn holding portion for end stitches has a recess on which a knitting yarn made of multiple yarns that is formed with a bundle of a plurality of fine yarns are converged on its lower side. Therefore, the knitting yarn made of multiple yarns is prevented from spreading and a part thereof is prevented from contacting the tongue top in the state where the needle hook of the compound needle is open.

Furthermore, according to the invention, the flat knitting machine comprises a loop presser including a loop presser portion serving a function of pressing the knitting stitch loop by advancing to a tooth mouth and a knitting yarn holding portion for end stitches serving a function of holding a knitting yarn fed from above the tooth mouth in the outside of a knitting end of a knitted fabric in the width direction in different positions in the advancing and retracting direction.

During knitting a knitted fabric, after a knitting yarn is fed from a yarn feeding port to the hook of the compound needle, the top portion of the loop presser can be advanced to the tooth mouth with a loop presser mechanism such that the loop presser portion is positioned in the tooth mouth. When a knitting end is made and the traveling direction of the yarn feeding port is reversed to start the next course, then the top portion of the loop presser can be advanced to the tooth mouth with the knitting yarn holding mechanism for end stitches such that the knitting yarn holding portion for end stitches of the loop presser is positioned on the side before the compound needle used at first for knitting in the tooth mouth. In the loop presser, the portion that acts on the tooth mouth is changed to obtain a shape for the exclusive purpose of each function so that each function can be improved. When the loop presser using the knitting yarn holding portion for end stitches and the loop presser using the loop presser portion are made to cooperate, even if the knitting yarn in the knitting end is held by the knitting yarn holding portion for end stitches and the knitting yarn is guided to the compound needle used at first in knitting of a next course by the loop presser portion, the tongue top of the slider is hidden by the wall portion on the upper side of the knitting yarn holding portion for end stitches, whereby the problem of yarn entanglement in which the knitting yarn is surmounted on the tongue and goes outside the hook can be prevented.

According to the invention, the auxiliary bed in which the loop presser advances and retracts is open downward on a base end side of the advancing and retracting direction, and a selecting mechanism is positioned below the open portion. The selecting mechanism attracts the base end side of the loop presser and can release the attraction selectively. The loop presser has a butt projected upward. A cam mechanism is provided above the auxiliary bed, and in the cam mechanism, a cam groove that is engaged with the butt and drives the butt to be displaced in the advancing and retracting direction is formed. The cam mechanism can switch function, either as the loop presser mechanism or the knitting yarn holding mechanism for end stitches, by selecting the cam groove engaged with the butt by releasing attraction to the base end portion of the loop presser with the selecting mechanism or not. Thus, switching can be performed with a single cam mechanism.

According to the invention, the cam groove of the cam mechanism is formed generally in linear symmetry with respect to a central line, and the top portion of the loop presser draws the same locus at the time of knitting on one side of a needle bed as that at the time of knitting on the other side, and the selecting mechanisms opposed with respect to the central line of the cam mechanism also can switch the cam groove in the reciprocal direction.

Furthermore, according to the invention, when knitting a knitted fabric with a flat knitting machine comprising at least a pair of needle beds in the front and the back, knitting can be performed reliably with a compound needle, using a loop presser having a portion serving a function of pressing a knitting stitch loop by advancing to a tooth mouth and a portion serving a function of holding a knitting yarn fed from above the tooth mouth in the outside of a knitting end of a knitted fabric in the width direction in different positions in the advancing and retracting direction. After a knitting yarn is fed to the hook of the compound needle, the loop presser advances the portion having the loop presser function of pressing a knitting stitch loop on the lower side to the tooth mouth, and advances the portion serving the knitting yarn holding function for end stitches of holding a knitting yarn fed from above the tooth mouth in the outside of the knitting end of the knitted fabric in the width direction, so that the function can be switched. Therefore, the portion that acts on the tooth mouth can be changed to obtain a shape for exclusive purpose for each function, so that each function can be improved.

The upper side of the portion serving the knitting yarn holding function for end stitches is utilized as a wall preventing the knitting yarn fed from the yarn feeding port from approaching a tongue top in a state where a hook of the compound needle is open. Therefore, when knitting a knitting stitch of a knitting end in the width direction of a knitted fabric, the problem of yarn entanglement of end stitches in which the knitting yarn is caught by the top of the tongue and goes outside the hook can be prevented, and the knitting yarn can be guided in the hook reliably.

According to the invention, the portion serving the knitting yarn holding function for end stitches has a recess on which a knitting yarn made of multiple yarns that is formed with a bundle of a plurality of fine yarns on the lower side. Therefore, even if a knitting yarn made of multiple yarns is used, the problem of yarn entanglement of end stitches in which a part of the knitting yarn is in contact with the tongue top in the state where the hook of the compound needle is open and goes outside the hook can be prevented reliably.

What is claimed is:

1. A loop presser in a flat knitting machine comprising at least a pair of needle beds including front and back needle beds, the pair of needle beds forming a tooth mouth, the front and back needle beds being opposed to each other and forming an angle such that top sides are oriented upward, and wherein compound needles are provided in each of the front and back needle beds as knitting needles, said loop presser having:

a top portion capable of advancing and retracting from an auxiliary bed supported on at least one of the front and back needle beds with respect to the tooth mouth in a process of making a knitting stitch loop from a knitting yarn fed from a yarn feeding port traveling in a longitudinal direction of the front and back needle beds above the tooth mouth to make a downwardly suspended knitted fabric, wherein said top portion has, at different positions in advancing and retracting directions of said loop presser,

a loop presser portion operable to guide the knitting yarn fed from the yarn feeding port to one of the knitting needles and press the knitting stitch loop between the knitting needles on a lower side, and

a knitting yarn holding portion for end stitches operable to hold knitting yarn fed from above the tooth mouth on the outside of a knitting end of a knitted fabric in a width direction;

wherein said knitting yarn holding portion has a pressing portion for pressing the knitting yarn suspended from the knitting stitch loop held by one of the compound needles in the knitting end to the yarn feeding port moving toward the outside of the knitted fabric on a lower side, and a wall portion preventing the knitting yarn fed from the yarn feeding port moving toward the inside of the knitted fabric by reversing the moving direction to the one of the compound needles in the knitting end from approaching a tongue top thereof having a hook open on an upper side thereof.

2. The loop presser of claim **1**, wherein the knitting yarn holding portion is nearer to an end of said loop presser, with respect to the advancing and retracting direction, than said loop presser portion.

3. The loop presser of claim 1, wherein said knitting yarn holding portion has a recess on which a knitting yarn, made of multiple yarns that are formed with a bundle of a plurality of fine yarns, can converge on its lower side.

4. The loop presser of claim 2, wherein said knitting yarn holding portion has a recess on which a knitting yarn, made of multiple yarns that are formed with a bundle of a plurality of fine yarns, can converge on its lower side.

5. A flat knitting machine comprising:

the loop presser of claim 1;

a loop presser mechanism that advances to and retracts from the said portion according to a predetermined locus so as to guide the knitting yarn fed from the yarn feeding port passing through a position of the compound needle for making the knitted fabric to a position where the knitting yarn can be held by a hook of the compound needle and press a knitting stitch loop which is knitted by the pressing portion; and

a knitting yarn holding mechanism for end stitches that holds the knitting yarn so as to advance the knitting yarn holding portion to the tooth mouth on the side before the compound needle used at first in knitting a knitted end, reversing a traveling direction of a yarn and starting knitting a next course,

wherein after the yarn feeding port passes through the compound needle used at first in knitting, the loop presser mechanism and the knitting yarn holding mechanism cooperate so as to prevent the knitting yarn, fed to the compound needle used at first in knitting by guiding by the loop presser portion of the loop presser that is advanced to and retracted from by the loop presser mechanism, from approaching a tongue top in a state where a hook is open by a wall portion on an upper side of said knitting yarn holding portion of said loop presser that is advanced and retracted by the knitting yarn holding mechanism.

6. The flat knitting machine of claim 5, wherein:

the auxiliary bed, in which said loop presser advances and retracts, is open downward on a base end side of the advancing and retracting direction,

said loop presser has a butt projected upward, and

said flat knitting machine further comprises:

a selecting mechanism that is opposed to a base end portion of said loop presser below an open portion of the auxiliary bed and can selectively attract and release said base end portion; and

a cam mechanism selectively functioning as said loop presser mechanism or said knitting yarn holding mechanism, said cam mechanism having a cam groove that is engaged with said butt above the auxiliary bed and drives said butt to be displaced in the advancing and retracting direction, wherein the cam mechanism can switch function either as said loop presser mechanism or said knitting yarn holding mechanism by selecting said cam groove engaged with said butt by releasing attraction to said base end portion of said loop presser with the selecting mechanism or not.

7. The flat knitting machine of claim 6, wherein said cam groove of said cam mechanism has a generally a symmetrical shape with respect to a central line parallel to the advancing and retracting direction of said loop presser so that said top portion of said loop presser draws the same locus when knitting on one side of the longitudinal direction of one of said needle beds as when knitting on the other side, and said selecting mechanism is positioned on one side and the other side of the needle bed in positions opposed to the central line of the cam mechanism and the same distance away from the central line.

8. A flat knitting machine comprising:

the loop presser of claim 2;

a loop presser mechanism that advances to and retracts from the said portion according to a predetermined locus so as to guide the knitting yarn fed from the yarn feeding port passing through a position of the compound needle for making the knitted fabric to a position where the knitting yarn can be held by a hook of the compound needle and press a knitting stitch loop which is knitted by the pressing portion; and

a knitting yarn holding mechanism for end stitches that holds the knitting yarn so as to advance the knitting yarn holding portion to the tooth mouth on the side before the compound needle used at first in knitting a knitted end, reversing a traveling direction of a yarn and starting knitting a next course,

wherein after the yarn feeding port passes through the compound needle used at first in knitting, the loop presser mechanism and the knitting yarn holding mechanism cooperate so as to prevent the knitting yarn, fed to the compound needle used at first in knitting by guiding by the loop presser portion of the loop presser that is advanced to and retracted from by the loop presser mechanism, from approaching a tongue top in a state where a hook is open by a wall portion on an upper side of said knitting yarn holding portion of said loop presser that is advanced and retracted by the knitting yarn holding mechanism.

9. The flat knitting machine of claim 8, wherein:

the auxiliary bed, in which said loop presser advances and retracts, is open downward on a base end side of the advancing and retracting direction,

said loop presser has a butt projected upward, and

said flat knitting machine further comprises:

a selecting mechanism that is opposed to a base end portion of said loop presser below an open portion of the auxiliary bed and can selectively attract and release said base end portion; and

a cam mechanism selectively functioning as said loop presser mechanism or said knitting yarn holding mechanism, said cam mechanism having a cam groove that is engaged with said butt above the auxiliary bed and drives said butt to be displaced in the advancing and retracting direction, wherein the cam mechanism can switch function either as said loop presser mechanism or said knitting yarn holding mechanism by selecting said cam groove engaged with said butt by releasing attraction to said base end portion of said loop presser with the selecting mechanism or not.

10. The flat knitting machine of claim 9, wherein said cam groove of said cam mechanism has a generally a symmetrical shape with respect to a central line parallel to the advancing and retracting direction of said loop presser so that said top portion of said loop presser draws the same locus when knitting on one side of the longitudinal direction of one of said needle beds as when knitting on the other side, and said selecting mechanism is positioned on one side and the other side of the needle bed in positions opposed to the central line of the cam mechanism and the same distance away from the central line.

11. A flat knitting machine comprising:

the loop presser of claim 3;

a loop presser mechanism that advances to and retracts from the said portion according to a predetermined

locus so as to guide the knitting yarn fed from the yarn feeding port passing through a position of the compound needle for making the knitted fabric to a position where the knitting yarn can be held by a hook of the compound needle and press a knitting stitch loop which is knitted by the pressing portion; and

a knitting yarn holding mechanism for end stitches that holds the knitting yarn so as to advance the knitting yarn holding portion to the tooth mouth on the side before the compound needle used at first in knitting a knitted end, reversing a traveling direction of a yarn and starting knitting a next course,

wherein after the yarn feeding port passes through the compound needle used at first in knitting, the loop presser mechanism and the knitting yarn holding mechanism cooperate so as to prevent the knitting yarn, fed to the compound needle used at first in knitting by guiding by the loop presser portion of the loop presser that is advanced to and retracted from by the loop presser mechanism, from approaching a tongue top in a state where a hook is open by a wall portion on an upper side of said knitting yarn holding portion of said loop presser that is advanced and retracted by the knitting yarn holding mechanism.

12. The flat knitting machine of claim **11**, wherein:

the auxiliary bed, in which said loop presser advances and retracts, is open downward on a base end side of the advancing and retracting direction,

said loop presser has a butt projected upward, and

said flat knitting machine further comprises:

a selecting mechanism that is opposed to a base end portion of said loop presser below an open portion of the auxiliary bed and can selectively attract and release said base end portion; and

a cam mechanism selectively functioning as said loop presser mechanism or said knitting yarn holding mechanism, said cam mechanism having a cam groove that is engaged with said butt above the auxiliary bed and drives said butt to be displaced in the advancing and retracting direction, wherein the cam mechanism can switch function either as said loop presser mechanism or said knitting yarn holding mechanism by selecting said cam groove engaged with said butt by releasing attraction to said base end portion of said loop presser with the selecting mechanism or not.

13. The flat knitting machine of claim **12**, wherein said cam groove of said cam mechanism has a generally a symmetrical shape with respect to a central line parallel to the advancing and retracting direction of said loop presser so that said top portion of said loop presser draws the same locus when knitting on one side of the longitudinal direction of one of said needle beds as when knitting on the other side, and said selecting mechanism is positioned on one side and the other side of the needle bed in positions opposed to the central line of the cam mechanism and the same distance away from the central line.

14. A method for making a knitted fabric using a loop presser in a flat knitting machine comprising at least a pair of needle beds including front and back needle beds, the pair of needle beds forming a tooth mouth, the front and back needle beds being opposed to each other and forming an angle such that top sides are oriented upward, and wherein compound needles are provided in each of the front and back needle beds as knitting needles, said loop presser having a top portion capable of advancing and retracting from an auxiliary bed supported on at least one of the front and back needle beds with respect to the tooth mouth in a process of making a knitting stitch loop from a knitting yarn fed from a yarn feeding port traveling in a longitudinal direction of the front and back needle beds above the tooth mouth to make a downwardly suspended knitted fabric, said method comprising:

forming, in the top portion of the loop presser, at different positions in the advancing and retracting direction,

a portion operable to guide the knitting yarn fed from the yarn feeding port to a position where the knitting yarn can be held by a hook of one of the compound needles and press the knitting stitch loop between the knitting needles on a lower side, and

a portion operable to hold knitting yarn for end stitches fed from above the tooth mouth on the outside of a knitting end of the knitted fabric in a width direction thereof;

switching the loop presser between being operable to press the knitting stitch loop and being operable to hold the knitting yarn by switching a position to which the top portion of the loop presser is advanced to the tooth mouth;

making the knitting yarn hold so as to advance the portion operable to hold the knitting yarn in the top portion of the loop presser to the tooth mouth on the side before the compound needle used at first in knitting in knitting a knitted end, reversing a traveling direction of a yarn and starting knitting a next course, pressing the knitting yarn suspended from the compound needle in which the knitting end is knitted to the yarn feeding port on the lower side of the portion operable to hold knitting yarn until the yarn feeding port passes through a position of the compound needle, and feeding the knitting yarn to the compound needle used at first in knitting from the upper side of the portion operable to hold knitting yarn; and

after the yarn feeding port passes through the compound needle used at first in knitting, making the loop presser cooperate so as to advance another loop presser to the tooth mouth and preventing the knitting yarn fed to the compound needle used at first in knitting by guiding with the portion serving the loop presser function from approaching a tongue top in a state where a hook is open with an upper side of the loop presser that advances the portion operable to hold knitting yarn to the tooth mouth serving as a wall.

15. The method of claim **14**, wherein the portion operable to hold knitting yarn has a recess on the lower side in a state where the portion operable to press the knitting stitch loop advances to the tooth mouth, and knitting is performed while converging a knitting yarn made of multiple yarns that are formed with a bundle of a plurality of fine yarns on the recess.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

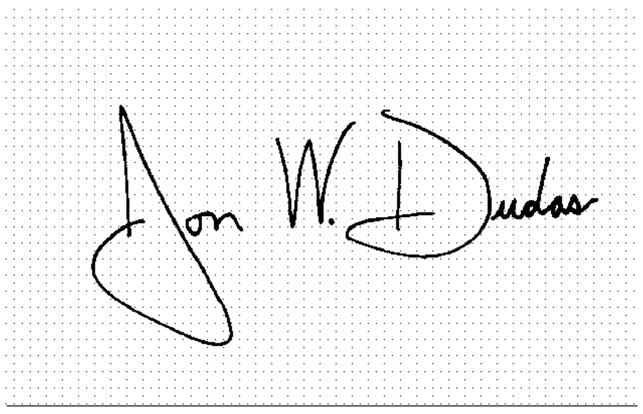
PATENT NO. : 6,883,352 B2
DATED : April 26, 2005
INVENTOR(S) : Takuya Miyai

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [54], Title, please change "**LOOP PRESSER, FLATBED KNITTING MACHINE HAVING LOOP PRESSER, AND FABRIC KNITTING METHOD USING LOOP PRESSER**" to -- **LOOP PRESSER, FLAT KNITTING MACHINE PROVIDED WITH LOOP PRESSER, AND METHOD FOR MAKING A KNITTED FABRIC USING LOOP PRESSER** --.

Signed and Sealed this

Twenty-third Day of August, 2005



JON W. DUDAS
Director of the United States Patent and Trademark Office